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I.

THE COMBINED INTRANASAL AND EXTERNAL
OPERATION ON THE LACRIMAL SAC.*
(MOSHER-TOTI.)

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My job, before I take the count, is to champion the combined intranasal and external operation on the tear sac. I shall first give the results of a series of combined operations and state the conclusions drawn from a study of the cases, then in order review briefly the applied anatomy of the operation, and describe the steps of the procedure. In closing I shall refer to certain important and special points connected with the operation. Also I shall distribute a few bouquets, mostly to myself, and metaphorically send a few flowers to my opponents.

RESULTS AND CONCLUSIONS.

During the past two years seventy-one cases of dachryocystitis have been operated by the combined intranasal and ex-

*Illustrations by the writer.

ternal operation. Forty-two (42) patients recently reported in answer to a follow-up letter, the purpose of which was to give an opportunity to check up end results. It was found in the review of the cases that the pus was cured in over ninety per cent of the patients, and the epiphora in seventy-five.

In the first cases of the series the skin incision healed as a disfiguring scar. Experience has shown that the incision should not be placed too near the inner canthus. At first the distance was 6 mm. or less, and it was made on a curve through-out. It is now placed at least 12 mm. from the inner canthus, and is made nearly straight. At present a flat, invisible scar is the rule. Experience has shown that the anterior end of the middle turbinate should be removed in all cases and the anterior ethmoidal cells adjacent to the inner sac wall curetted if a lasting result is to be obtained. It has been found equally important to correct a high obstructing deviation of the septum. Three cases in which this was not done were better for a while, then relapsed. They were taken into the hospital and the septal deformity corrected.

Before operating on the sac stricture of the canaliculus should be excluded. Two partial failures in the series of combined operations were due to overlooking this condition.

THE APPLIED ANATOMY OF THE LACRIMAL SAC.

The posterior half of the bed of the sac is made by the thin lacrimal bone, the anterior half by the stout posterior edge of the ascending process of the superior maxilla. It is easy to enter the nose through the posterior half of the bed of the sac. One of the anterior ethmoidal cells, the lacrimal or the unciform cell, overlaps a part of the bed of the sac. This cell varies greatly in size. In series with the lacrimal cell and in front of it a second anterior ethmoidal cell—the agger nasi—is often found. This overlies the inner surface of the ascending process of the superior maxilla over the prominence of the process called the agger nasi. In entering the nose from the orbit by way of the bed of the sac one or both of the ethmoidal cells just mentioned must be opened. In approaching the sac intranasally the same cells are encountered. Owing to the thickness of the ascending process of the maxilla in front of the sac the intranasal approach to the sac is round a corner or through the thickest part of the ascending process.

The tip of the middle turbinate overlies the unciform cell, and a part or the whole of the agger nasi cell when this is present. In order, therefore, to get a free opening into the nose opposite the lacrimal sac it is necessary to remove the tip of the middle turbinate and the lacrimal and the agger-nasi cells.

The inner bony wall of the nasal duct has the same two components as the bed of the sac. It is hard to open the nasal duct thoroughly from the nose, but easy to do from the orbit.

THE COMBINED OPERATION ; INTRANASAL PROCEDURES.

The intranasal part of the operation consists in removing the anterior end of the middle turbinate and in curetting the anterior ethmoidal cells.

The removal of the tip of the turbinate can be done a few days before the operation. This gives somewhat less bleeding at the operation on the sac. If the operator prefers, the curetting of the anterior ethmoidal cells can be done later through the opening made into the nose in the third step of the operation. The removal of the middle turbinate tip also can be done at this time, thus making the whole operation on the sac an external operation done wholly by sight.

In whatever way these preliminary procedures are carried out, the usual care should be taken not to wound the mucous membrane of the septum for fear of subsequent nasal adhesions.

Experience has shown that it should be made a routine to remove the tip of the middle turbinate, and the overlapping anterior ethmoidal cells. An obstructing high deviation of the septum should be corrected before the operation on the sac if a lasting result is to be secured.

THE COMBINED OPERATION ; EXTERNAL PROCEDURES.

The First Step. The Incision.—The incision is placed half way between the inner canthus of the eye and the edge of the bridge of the nose. It begins on a level with the summit of the globe and is carried downward in a nearly straight line a centimeter and a half to two centimeters. It is carried to the bone throughout its whole length. With a flat chisel the subcutaneous tissues, the internal palpebral ligament and the peri-

osteum are separated from the ascending process of the superior maxilla. The subcutaneous tissues and the periosteum over the nasal bone are undisturbed.

Bleeding is controlled by placing metal clips on the edges of the incision. It was found that selfretaining retractors get in the way. The incision is held open by forceps or by small double hooks.

In order to get a flat invisible scar my experience to date may be summarized as follows:

1. Make the incision at least 12 mm. from the inner canthus.
2. Make the incision practically straight.
3. The length of the incision varies between $1\frac{1}{2}$ and $2\frac{1}{2}$ cm.
4. Do not elevate the subcutaneous tissues and the periosteum from the nasal bone.
5. Do not bring the bone opening so far forward that the skin incision lies over it.
6. Suture the anterior edge of the outer or remaining sac wall to the periosteum or the subcutaneous tissues over the nasal bone.
7. In closing the incision take time enough and put in enough sutures to get good coaptation.

The Second Step. Turning the Sac Out of Its Bed.—The sac is turned out of its bed by entering the orbit with the flat chisel above the sac and working downward and backward. The elevation of the periosteum from the inner wall of the orbit is carried a little beyond the crest of the lacrimal bone. This allows the sac to be turned well outward. Inferiorly the beginning of the nasal duct should be exposed and the surface of the ascending process of the superior maxilla opposite the beginning of the duct.

The Third Step. Making the Nasal Opening.—The third step consists in making an opening into the nose opposite the lacrimal sac the size of the sac. The opening is started by forcing a Citelli punch through the posterior part of the bed of the sac because the posterior half of the bed of the sac is made by the thin lacrimal bone. The opening is enlarged upward to the top of the bed of the sac, and backward to the crest of the lacrimal bone. Anteriorly

a little of the posterior edge of the ascending process of the superior maxilla is bitten away. Usually the Citelli punch is not strong enough to cut the ascending process of the superior maxilla, and it must be replaced by a large Kerrison punch.

In making the opening into the nose the nasal mucous membrane is trimmed flush with the bone opening. The anterior end of the middle turbinate is removed to the posterior rim of the opening. Any anterior ethmoidal cells which overlap the nasal opening are similarly dealt with.

In removing or trimming the anterior end of the middle turbinate the conchotome or ring punch can be introduced from below upward through the nose and watched through the nasal opening or introduced directly into the nasal opening.

The Fourth Step. The Removal of the Inner Half of the Sac.—The fourth step consists in removing the inner half of the sac. This is best accomplished by making a perpendicular incision along the full length of the anterior edge of the sac. From the top of this incision, and making a right angle with it, a second incision is carried horizontally backward across the summit of the sac. The incisions can be made entirely with a knife, or started with a knife and finished with scissors. The two incisions allow the inner wall of the sac to be turned inward and backward as a single flap. By steadying this with forceps it is easy to cut downward paralleling the posterior edge of the inner wall of the sac, and to remove it as one piece.

If the two walls of the sac are adherent a probe passed through the canaliculus into the sac is a great help in starting the first incision.

The Fifth Step. Removal of the Inner Wall of the Nasal Duct.—The fifth step consists in the removal of the inner bony wall of the nasal duct down to the upper edge of the inferior turbinate. This is accomplished by straddling the inner wall of the duct with a small conchotome and biting downward. This removes a part of the inner bony wall of the duct but leaves a sharp spur which is the anterior portion of the inner wall of the duct projecting backward from the posterior surface of the ascending process of the superior maxilla. The spur is removed by downward strokes of a chisel. After the removal of the spur the mem-

branous nasal duct is widely exposed. The inner wall of the membranous nasal duct is now removed with scissors or conchotome.

The Sixth Step. The Closing of the Wound.—If there has been much bleeding from the ethmoidal region the upper part of the nose is lightly packed with a narrow strip of gauze liberally smeared with vaseline. Otherwise no packing is used. In the first operations the incision was closed with fine silk sutures, the eye cleansed, the lids anointed and the eye closed and covered with a pressure bandage. Before closing the incision I now suture the anterior edge or the remaining or outer wall of the sac to the cut edge of the periosteum over the nasal bone. One or two sutures of small plain catgut are used for this purpose. This is done on the theory that it prevents sagging of the subcutaneous tissues and makes a better scar.

The nasal packing is removed in twelve to twenty-four hours. If there is much edema after the operation the lower part of the incision is opened with a probe and the pressure bandage is renewed daily for three or four days after cleaning the cornea and anointing the lids. If there is little edema the bandage is discarded in forty-eight hours. If the incision suppurates the lower part is opened, the bandage left off, the eye cleaned frequently, and hot applications applied. A suppurating incision usually becomes clean in a week or ten days.

HOW THE COMBINED OPERATION DIFFERS FROM THE TOTI OPERATION.

In the combined operation the anterior end of the middle turbinate and the overlapping anterior ethmoidal cells are removed as a routine. Toti practiced these procedures only when he felt that they were necessary. The correction of a high deviation of the septum is believed necessary as a preliminary to the combined operation. Submucous resection of the septum was not extensively practiced, if at all, when Toti published his operation.

In the combined operation the first opening into the nose is made through the thin lacrimal bone, not by attacking the ascending process. Toti saves the nasal mucous membrane

until the bone opening is completed. In the combined operation no attempt is made to save it, but instead it is removed along with the bone and then trimmed flush with the bone opening. The bony internal wall of the nasal duct and the inner membranous wall of the duct are removed down to the upper edge of the inferior turbinate.

REMARKS ON THE COMBINED OPERATION.

Crusting of the Middle Meatus.—Crusting in the middle meatus after the combined operation has caused many a solemn nodding of the head. Experience has shown that the fears on this score are groundless. Blowing of nasal secretion into the eye, another obsession of some ophthalmologists, has not occurred.

The Scar.—One keloid of the scar—which is disappearing under X-ray—and three or four bowstring scars have resulted in seventy cases of the combined operation. They occurred in the first operations in which the incision was made curved throughout and too near the inner canthus.

Probing After the Combined Operation.—Probing was not used in the after treatment. There is no law against using the probe should it be indicated. Patients, of course, shun it. One should stand ready to use the probe whenever it is indicated. The follow up shows that nine (9) cases need probing.

A Slit Canaliculus.—In order to get a cure of epiphora, one would naturally suppose that both puncta and both canaliculi would have to be intact and functioning. This is not necessarily the case. One patient, a boy of twelve, had the lower punctum sealed and pus coming only out of the upper one. This boy, however, had a perfect result in the cure of pus and epiphora. One patient who was operated for recurrent abscesses had laking in the inner canthus and but little epiphora. The lower canaliculus was permanently slit for 3 mm. To date—four months—she remains cured of the pus and the recurring abscesses, yet the laking and the epiphora remain the same. On the other hand, a woman in the sixties had the lower canaliculus permanently slit for what appeared to be its whole length. She, however, is entirely cured of the epiphora. These cases would seem to show that if the lower canaliculus is slit for a part or the whole of its course one

cannot predict what the result of the operation will be, as far as the epiphora is concerned.

The Use of the Silver Wire Style.—In cases which have been neglected, that is, cases which have come to a permanent fistula, and in cases which have been hacked at and the sac partially removed—and there are many such—one or both of the canaliculi may be closed and the common punctum sealed. In such cases it is possible to obtain an occasional success by doing the combined operation, forcing open one or both canaliculi and the common punctum and introducing a style of silver wire and leaving it some six weeks.

The Hydraulics of the Sac.—Our conception of the hydraulics of the sac have been upset by the success of the intra-nasal and the external operations. The long arm of the syphon which sounds so well from the standpoint of physiology is surgically done away with in these operations but still the sac drains. I have wondered whether the passage of the air through the inferior meatus in the normal case does not by suction help to empty the nasal duct and the sac. It is partly on this theory that I insist on making a new meatus opposite the common punctum of the sac so that the air can freely circulate there. In one case in which the lower punctum was sealed the upper punctum carried on adequate drainage after the combined operation.

TWO SIDE REMARKS.

Probing of the Nasal Duct.—Probing of the nasal duct is a natural procedure to try. It will occasionally succeed in the less severe cases such as those usually met with in private practice. Hospital cases are of another type and probing in these cases has not a good record.

Rapid dilatation of the nasal duct is an operation which will succeed at times. It easily becomes brutal. This operation raises its head every five or ten years. Probably it will do so periodically until the millennium.

Extirpation of the Sac.—Extirpation of the sac is admittedly an illogic, not a physiologic operation. It will, of course, cure the pus, but Gilbert's figures from the Massachusetts Charitable Eye and Ear Infirmary show that in fifty per cent of the cases so operated the eye remains disabled by persis-

tent epiphora. Any frank set of figures—not to use the harsher word—I believe will show the same result. Extirpation should be reserved for the old and feeble.

THE FOLLOW UP.

Three weeks ago, in order to check up the results to date of the operated cases, the patients were asked to report at the hospital. Forty (40) patients reported in two (2) groups of twenty (20). Two (2) private cases were personally seen and added to the list. The first and so the older cases came in the first group. The time that had elapsed since the cases were operated varied from nine (9) months to two (2) years for the combined operations, and three (3) years and over for the intranasal operations.

First Group. Twenty (20) Cases Reported.—One had a double sac operation.

Of the twenty (20) cases two (2) were intranasal operations (Mosher), and eighteen (18) were the combined intranasal and external operations.

The two (2) intranasal operations were perfect results both as to pus and epiphora. Two (2) more intranasal cases out of a series of seven (7) have been traced. These also are perfect results. These cases are all three or more years operated.

There was one (1) failure in the eighteen (18) cases of the combined operation. This patient had tuberculosis of the sac (two cases of tuberculosis of the sac have been found in seventy-one [71] operations on the sac). She had temporary relief for a few weeks, but today, a year and a half after the operation, there is constant pus and epiphora.

There were two (2) partial failures in the eighteen (18) cases. The first of the two (2) was an old syphilitic. She was cured of the pus but still has some epiphora. The second patient had smallpox as a child and since that time has had a chronic blepharitis with narrowing of the palpebral fissure. This patient was operated on for epiphora only.

Both of these cases are to be put on probing.

Fifteen (15) of the eighteen (18) cases had perfect results in the cure of the pus and epiphora.

Three (3) of the eighteen (18) cases had a marked bow-string deformity of the scar.

Six (6) of the eighteen (18) cases had a slightly elevated or bowstring scar in some part of its course.

In all of the patients with deformed scars the incision was placed 6 mm. or less from the inner canthus and was made on a curve throughout. All of these were early cases.

Second Group. Twenty-two (22) Patients Reported. Twenty-four (24) sacs, two (2) patients had a double sac operation.

One (1) failure, a boy of nine, who had constant epiphora and no pus. This boy is to be given ether and explored with probe.

All the other cases were operated for pus and epiphora.

Twenty-two (22), or all the sacs which had pus, were cured of pus.

Seven (7), or about a third, had the epiphora markedly bettered but not cured. These cases are now in line for probing.

Nineteen (19) out of twenty-four (24) patients had no deformity of the scar.

Five (5) cases had a partial bowstring of the scar.

One (1) case had a marked bowstring deformity of the scar.

Three (3) of the partial failures in clearing up the epiphora had a mucous operation done subsequent to the sac operation. One case was bettered for one month, one (1) for three months, and one case has not been heard from.

COMBINED SUMMARY.

Four (4) out of seven (7) cases of intranasal operations on the tear sac are known to be a success, both as to the cure of pus and epiphora, after a period of three years.

Of forty-three (43) sacs reporting out of seventy (70) operated on, thirty-seven (37) were perfect results.

Two (2) were failures, one as to pus and epiphora, one as to epiphora only.

Nine (9) were partial successes as to epiphora.

Four (4) had marked bowstring deformity of the whole scar.

Eleven (11) had bowstring deformity of some part of the scar.

In other words, the pus was cured in over ninety per cent of the cases.

The epiphora was cured in 75 per cent.

Some deformity of the scar occurred in about a third of the cases. The deformed scars, however, were in the early cases in which the incision was made too near the inner canthus. The incision is now made at least 12 mm. from the inner canthus and it is made nearly straight. A flat, practically invisible scar is now the rule.

THE CAUSES OF FAILURE.

Five (5) of the nine (9) partial failures of the combined operation have been reexamined.

In one (1) case, a No. 5 probe passed easily into the nose. Patient has tearing once every hour.

In one (1) case there was a stricture of the lower canaliculus. Patient was tearing three or four times a day.

In one (1) case the lower punctum was tight and the probe would not pass the common opening of the canaliculi into the nose. Patient has epiphora every two hours.

In one (1) case water would syringe through the canaliculus into the nose, but a No. 2 probe would not pass. Patient has tearing once a week.

In one (1) case the probe passed but met with a narrowing at the common opening of the canaliculi into the nose. Patient has tearing three or four times a day.

It would seem, therefore, that the use of the probe or possibly the silver wire will be necessary in the after treatment of a certain number of cases operated by the combined method.

The post operative examination of these cases has shown that after the external operation—and the same should be true after the intranasal—it is not always easy for the probe to find the common opening of the canaliculi. The removal of the bony bed of the sac leaves its outer wall somewhat afloat. Therefore, in passing the probe, the canaliculus may kink ahead of it, and on looking into the nose the bulging wall of the sac is seen instead of the presenting end of the probe.

In the cases in which the combined operation has given only a partial success, Dr. Finck, who has been my mainstay in the follow up examination of the cases, has not felt like forcing the probe into the nose at the first examination if it passed hard. He feared making a false passage and endangering

whatever result had already been gained. Given a case in which the combined operation proved a total failure due to a stricture of the canaliculus or to a closure of the common opening of the canaliculi into the nose—the two chief causes of the partial failures—I should not hesitate to force the probe into the nose even at the first sitting. This would be the way in which I should first attempt to retrieve such a case. The probe once in the nose, I should follow it by the insertion of a silver wire style and leave this in place for some six weeks. The use of the style was a routine in my last intranasal cases.

The stricture of the canaliculus found in one of the cases antedated the operation and might have been caused by probing.

In the other cases the narrowing of the common opening of the canaliculi into the nose or its closure can be accounted for in two ways, trauma of the sac at the operation or narrowing afterwards as a result of the long standing infection.

A stricture of the canaliculus should be ruled out before operation. If the condition of the common opening of the canaliculi is not known, the degree of patency can be determined at the operation by syringing through the canaliculus after the inner wall of the sac has been removed. Probing should be tried at this time very gently for fear of making the familiar false passage.

Since the 42 cases reported nine more patients have been checked up. Two of these were private patients of mine. The rest were partly private and partly hospital cases of other operators. They change the statistics only for the better. One of my two in this supplementary list had a slight deformity of the scar. All the other cases had no deformity. One case which was operated for epiphora only showed no improvement for two months after the operation. Then the case was probed and the epiphora ceased. All the cases were cured of pus. One case which was operated for frequently recurring abscesses—this case is mentioned above—had laking of the inner canthus and but little epiphora. She has a permanently slit canaliculus and the epiphora and laking are unchanged.

There have been 71 cases of the combined operation in this vicinity. Forty-two of the cases are mine. Dr. C. T. Porter has done 15.

Of the 51 cases which have been checked up and are here reported, I operated 26, Dr. C. T. Porter operated 12, house officers under supervision 5, Dr. W. I. Wiggin 4, Dr. H. P. Finck 4, Dr. H. P. Cahill 1.

In a former reprint I have stated my indebtedness to Dr. Porter and to Dr. Finck for valuable suggestions. I wish again to express my thanks for their help.

CONCLUSIONS.

The follow up on these cases shows that both the intranasal and the combined intranasal and external operation will succeed and that their results to date—a period of two to three years—are permanent. The only drawback which the combined operation has developed is the deformity of the scar in the first cases. The later cases show that this can be avoided by properly placing the incision.

Having tried both operations—I first did a series of seven intranasal operations before I changed to the combined operation—I should compare the two operations as follows: Both will succeed; that is, both will cure the pus and the epiphora. The results of both operations are permanent. For me, at least, the intranasal operation is more difficult, is indirect, and to a great extent blind. There is always danger of opening the orbit by a misstroke and infecting it. The combined operation is easier than the intranasal. It is direct and done by sight. There is less danger of opening the orbit. If external drainage should become necessary for any reason, it is always possible to get it by reopening the incision. The intranasal operation, in my opinion, is not fitted to deal with the complicated cases (patients with permanent fistulæ or with partially removed sacs). The combined operation can deal successfully with every type of case.

One member of this audience is a strong rooter for the intranasal operation. This is natural because he was cured by it some six or seven years ago. I can easily understand his enthusiasm. It should be remembered, however, that all doctors prefer on themselves what they consider minor surgical measures. Another member of this audience is considering the combined operation. He is waiting for me to say the word when I feel that my results warrant it. I am ready for him if he is still of the same mind.

To conclude: In deciding which operation your patient shall have, do not think only in terms of rhinology or only in terms of ophthalmology. Be bigger than the "learned narrowness" of the single specialty; think in terms of both. Learn how to do the combined operation. If your instincts are surgical you will prefer it.

828 BEACON STREET.

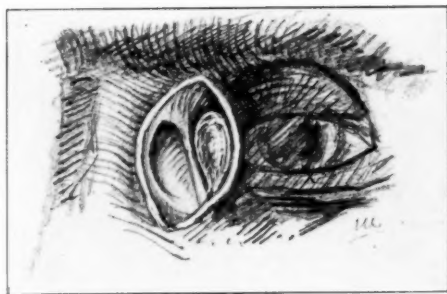
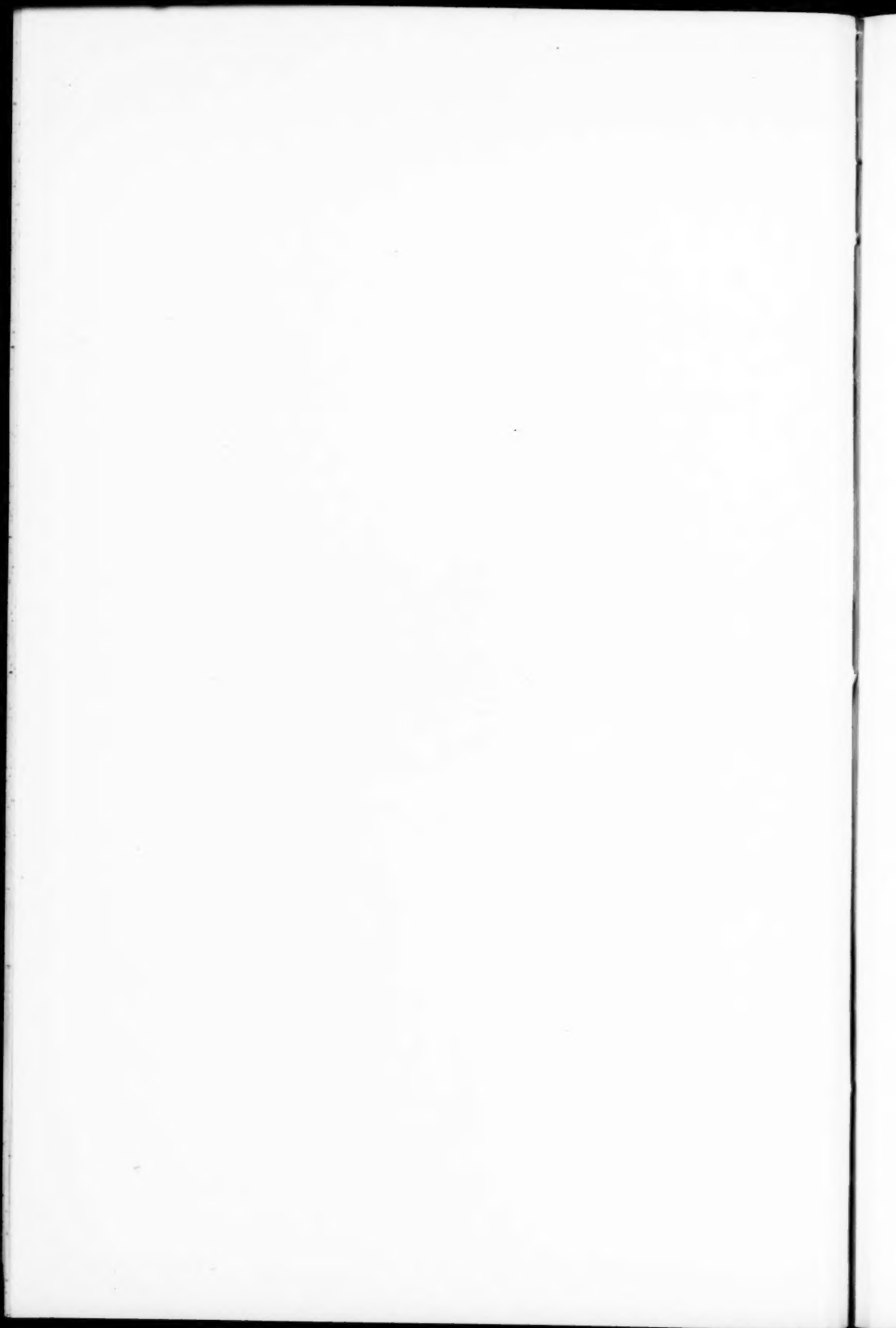


Fig. 1.

Drawing to show the sac turned out of its bed.



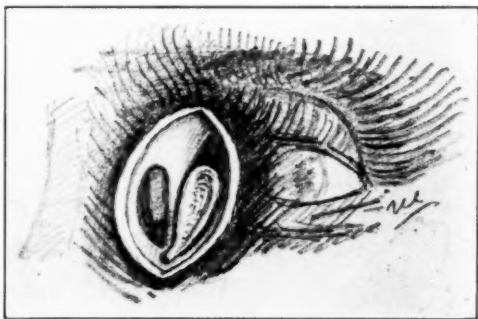
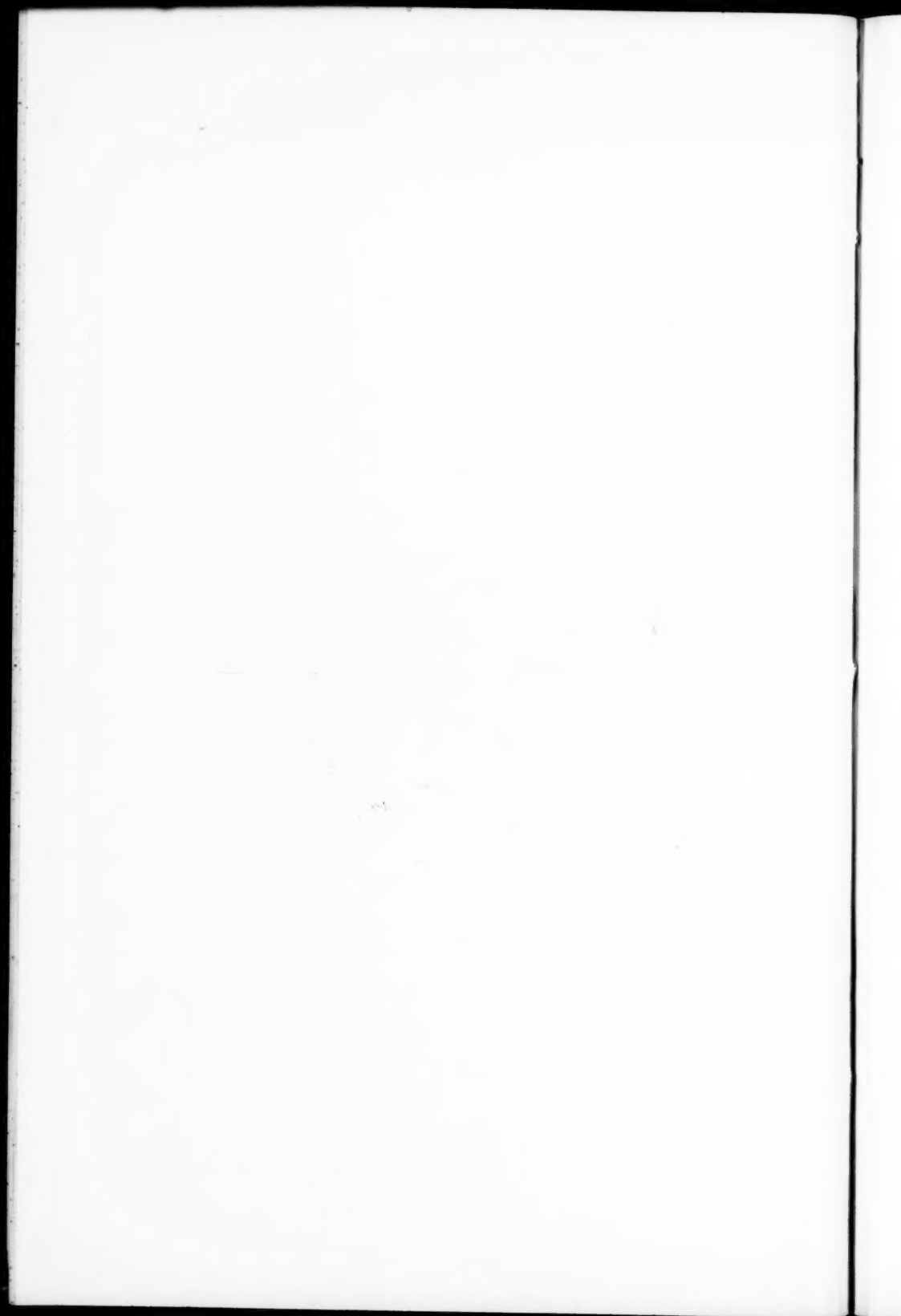


Fig. 2.

Drawing to show the opening made into the nose. In this opening the middle turbinate is seen. The anterior end of the turbinate has been removed.



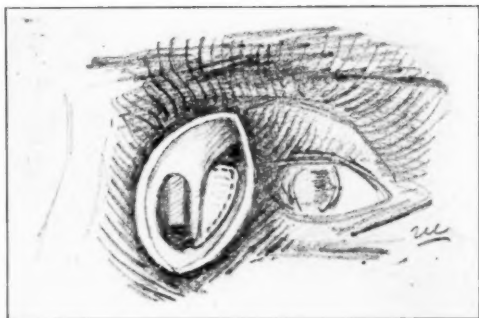
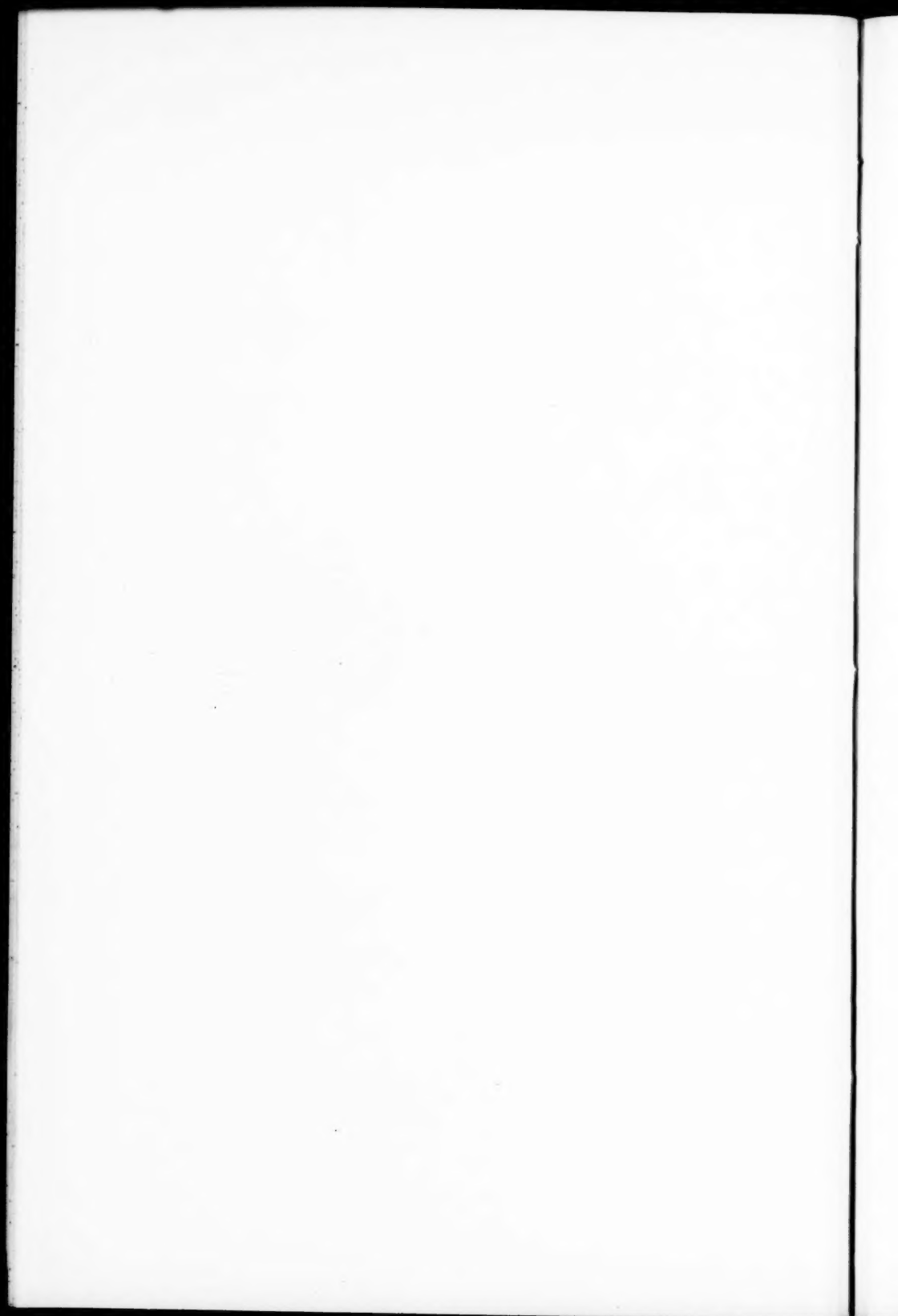


Fig. 3.

Drawing to show the incisions by which the sac is opened and its inner wall turned backward as a single flap. The dotted lines indicate the incisions.



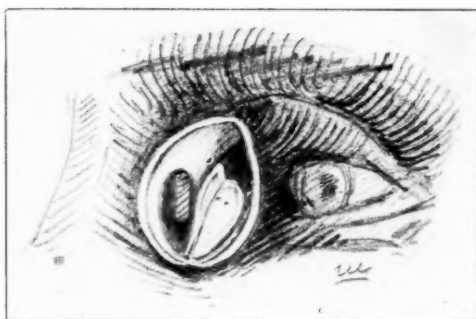
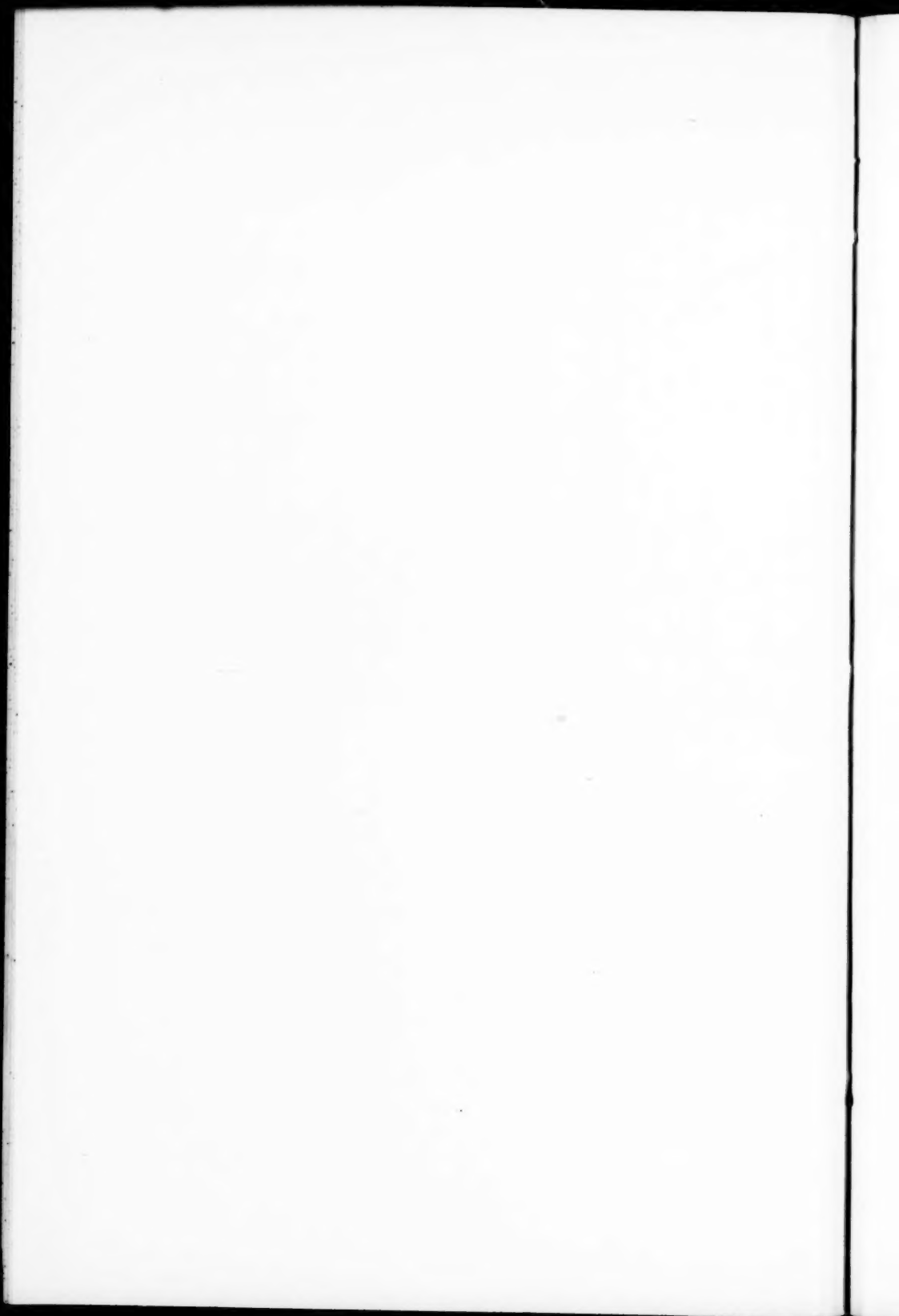


Fig. 4.

Drawing to show the inner wall of the sac turned upward and backward as a single flap. Making this flap is the first step in the removal of the inner wall.



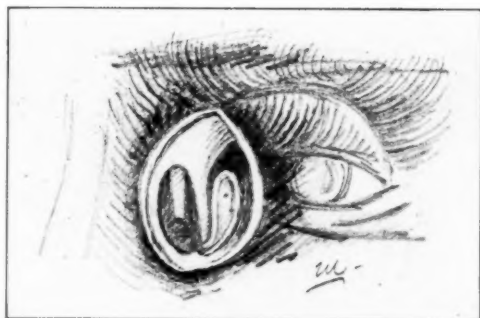
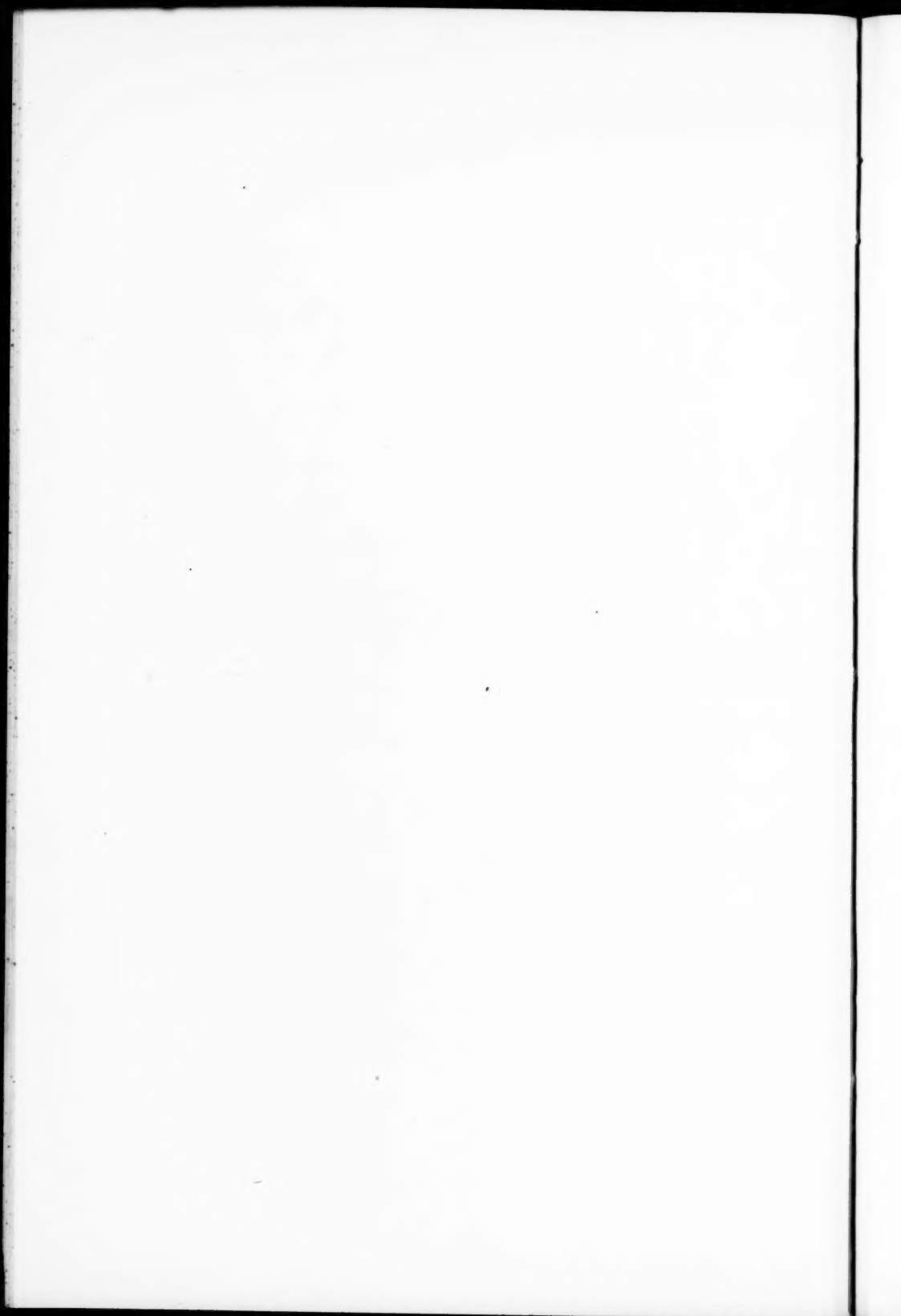


Fig. 5.

Drawing to show the completed operation. The inner wall of the sac has been removed. The inner wall of the bony canal in which the nasal duct lies has been removed down to the top of the inferior turbinate. The inner wall of the nasal duct has been removed.



II.

DACRYORHINO CYSTOTOMY: COMBINED METHODS.

BY W. E. SAUER, M. D.,

ST. LOUIS.

Our excuse for presenting this method is its simplicity, easy execution and satisfactory results.

There is probably a little misunderstanding about the terms "combined" and "intranasal" operations, as Mosher has just termed his The Combined Operation.

The operation I am about to describe is really an intranasal, with the probe passed into the sac from without. Since the time when West first introduced the intranasal operation, there have been a great many modifications. Our operation is, I believe, one of the simplest. Some operators, like Clark, introduce a probe after first making a stab incision into the sac from the skin, then doing an intranasal operation. The same principle is carried out by Blakesley of Kansas City, who makes a small incision and then introduces a trephine to make his entrance into the nose. So far as I know, he pays no attention to the interior of the nose, doing it simply by the sense of touch.

The operation which Dr. Wiener and I have been doing is the outcome of the rapid dilatation operation of Ziegler. The conception of our plan arose from passing a Ziegler probe in a case of congenital dacryocystitis in a girl, aged 4 years, April, 1911, in whom we found, on examining the nose, that the probe had not gone down the duct into the valve of Hasner, but had made a false passage through the lower end of the sac into the nose. It occurred to us then that it would be good practice to break through the nose intentionally in this manner and, utilizing the projecting end of the probe as a guide, which furnished a definite point on the inner wall of the sac, proceed to enlarge the opening upward, exposing the entire

nasal wall of the sac and affording even better drainage than that obtained through the small opening made by the Ziegler probe.

As shown in Plate 1, a Ziegler probe is first introduced through the inferior canaliculus into the lacrimal sac. The probe is then directed downward until it reaches the bottom of the sac, when it is turned inward at an angle of 45 degrees and then forced through the external nasal wall into the nasal cavity, as shown in Plate 2. In some cases a punctum dilator must be used before the Ziegler probe can be introduced. In a few cases we were unable to introduce the probe through the lower canaliculus, but had no difficulty in going through the upper one. In none of the cases did we find it necessary to slit the punctum.

The probe usually enters the nasal cavity just anterior to the anterior end of the middle turbinate, as in Plate 3. When the middle turbinate is large, it may be necessary to remove a portion of the anterior end immediately before the introduction of the probe. If the nose is narrowed by a septal deviation, a submucous resection must precede this operation, though in the majority of cases, while this is desirable, it is not necessary.

One of the great advantages of the Ziegler probe is that it shows the relative position of the sac. In all the nasal operations in which the Ziegler probe is not introduced there is no way of determining just where the sac is located. In some cases it is very prominent; in others it is impossible to tell the relation of the sac with the anterior end of the middle turbinate, for it is not constant. In some the anterior end covers the sac; in others it is directly in front of the middle turbinate; and in still others it is behind. Therefore, the position of the probe gives the exact position of the sac.

The next step is to withdraw the probe partially, as in Plate 3, leaving the point visible in the nose to serve as a guide for the removal of the bony covering of the canal and the lacrimal sac as far as necessary to establish a permanent opening. The opening made by the probe is then enlarged by means of an

electrically driven burr, about 2 mm. in diameter, as in Plate 4. The opening is enlarged upward and forward until it attains a diameter of between 8 to 10 mm. and is extended upward so that the probe may be introduced into the nose almost at right angles. That is, the handle of the probe, instead of being almost vertical as when pushed into the nose, may now be introduced in a horizontal position. It will now be found that a portion of the sac may be pushed through the bony opening into the nasal cavity by means of a probe, which is substituted for the Ziegler. (This is shown in Plates 5 and 6.) With the sac held in this position, biting forceps are introduced into the nose and as much of the sac as possible is grasped between the jaws and held there. The probe is removed and the jaws of the forceps closed, as shown in Plate 7. A portion of the sac is thus removed. The opening in the sac as well as that of the bone may be further enlarged by means of the forceps shown in Plate No. 8.

When the operation is completed the point of an Anel syringe is introduced in the canaliculus and the sac cavity thoroughly irrigated through the nose. This is repeated daily. The bleeding is usually very slight; in no case has packing been required. On the third day a probe is introduced into the nose. This may be required several times. Granulations are kept down by means of a 40 per cent solution of silver nitrate until the wound in the nose is entirely healed. The introduction of the probe and the applications of the silver solution are the chief points in the success of the operation. As in other similar operations, if the patient is not carefully watched, the opening may close.

With regard to the results, Mosher has just told you that results can be obtained with both the combined and intranasal methods. In 1914 West reported over 400 cases with 90 per cent successes with this method. If we can obtain such a result as that, the intranasal operation is certainly worth while. Our results have been fully as good as this with a much simpler method. The contraindications for this method, as Mosher also pointed out, are those cases in which the sac has been practically obliterated. In those cases I am willing to

agree with Mosher that his operation will come into place, but I cannot see any real objection to doing the intranasal operation prior to doing Mosher's operation, which is very much more favorable. The forcing of the probe from the bottom of the sac into the nose converts the West operation from one of great difficulty into a very simple procedure, by serving as a positive guide to the nasal location of the sac.

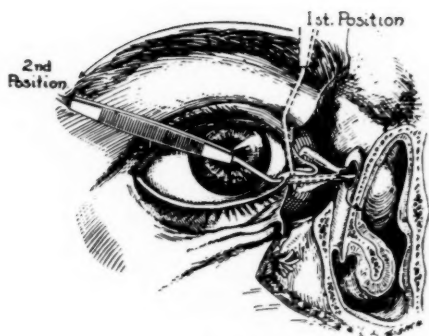


Fig. 1.
Path of probe from time of its introduction.

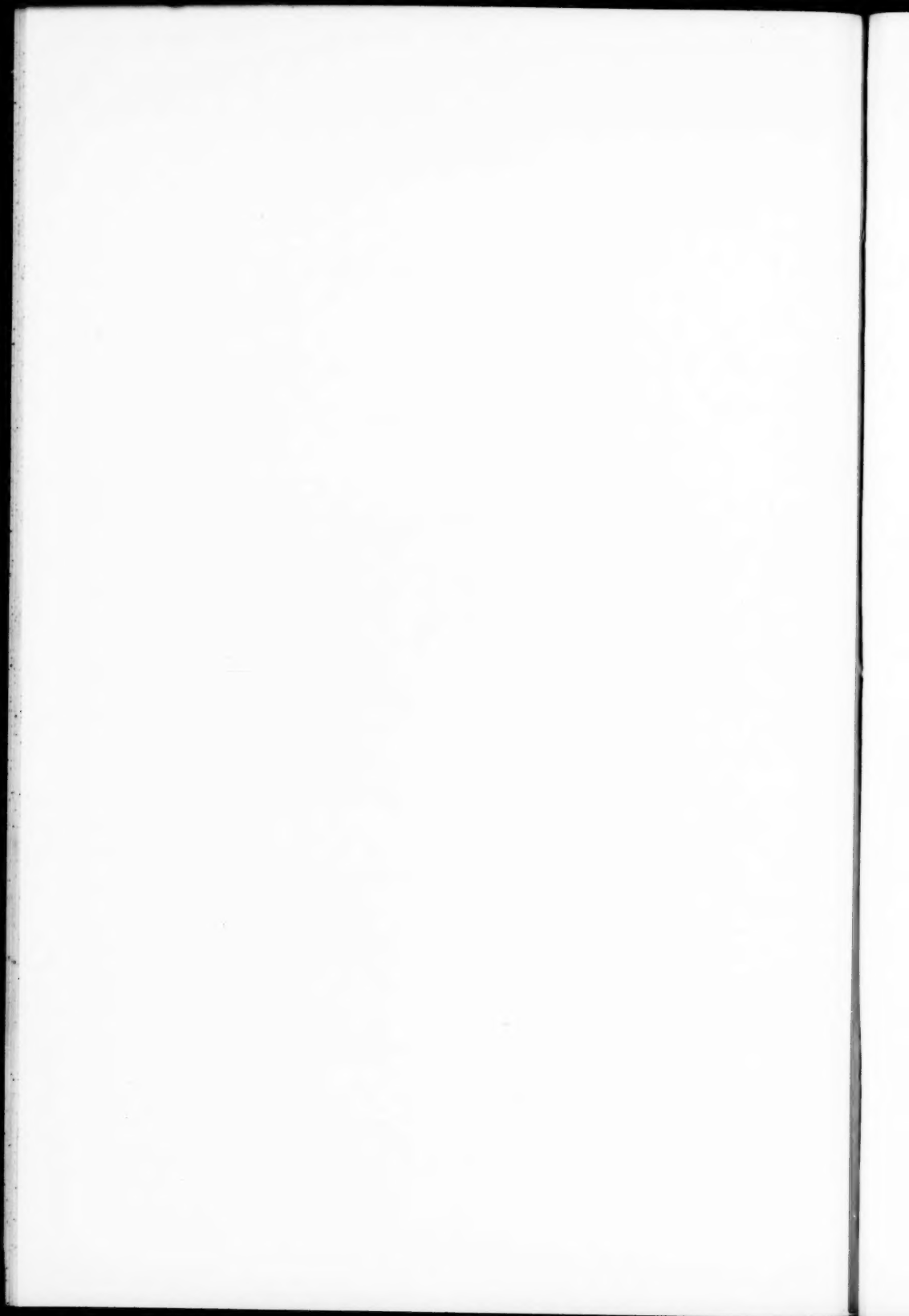
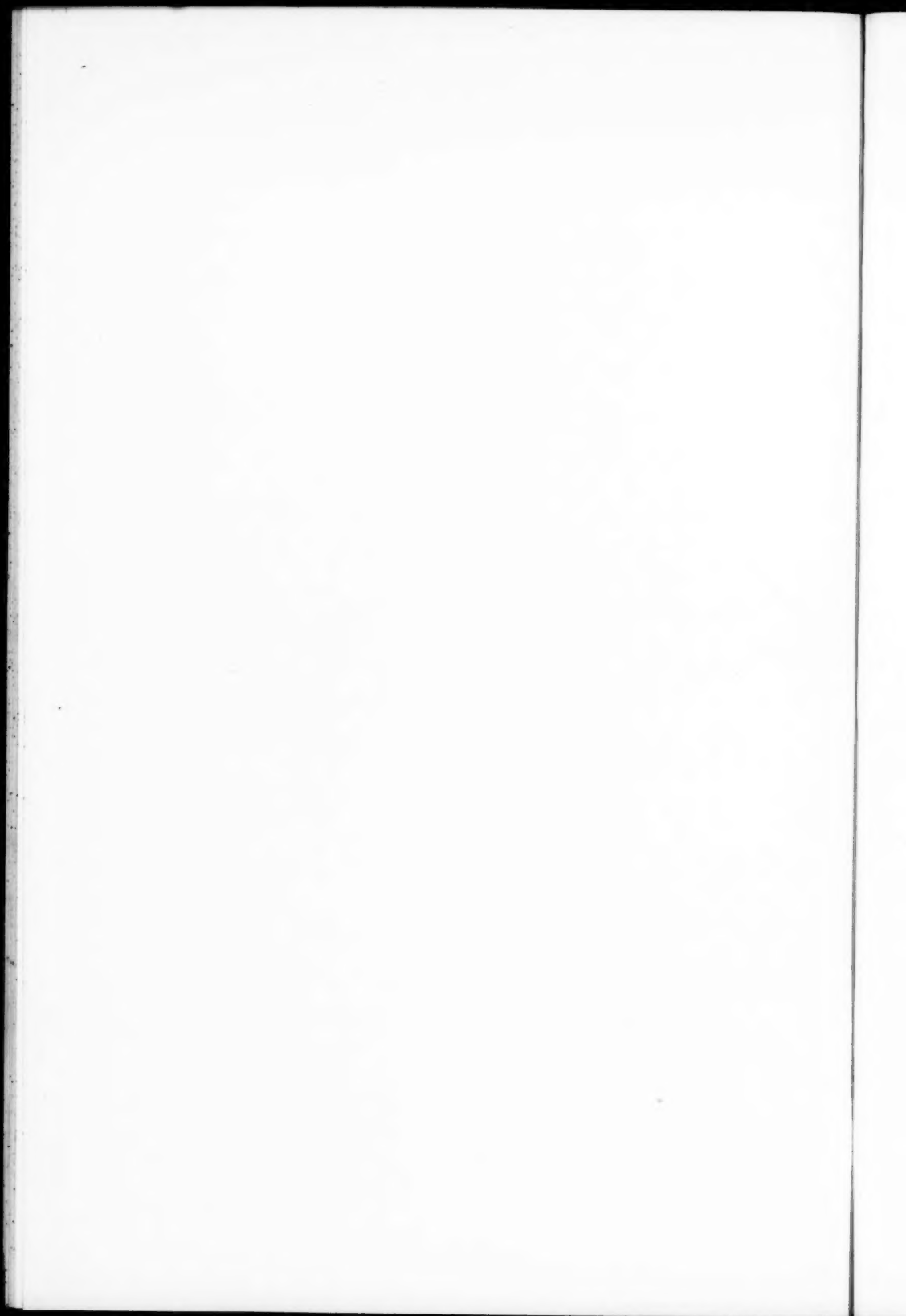




Fig. 2.

Direction of probe as it is forced into nose from
bottom of sac.



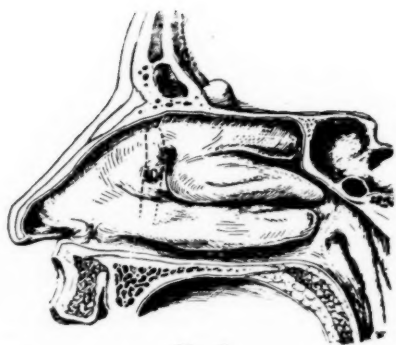


Fig. 3.
Position of probe as it emerges just anterior to
middle turbinate. Dotted line is sac and duct.

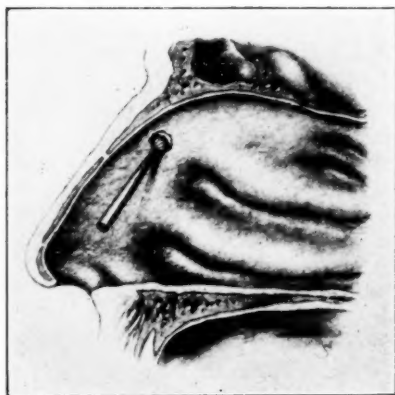
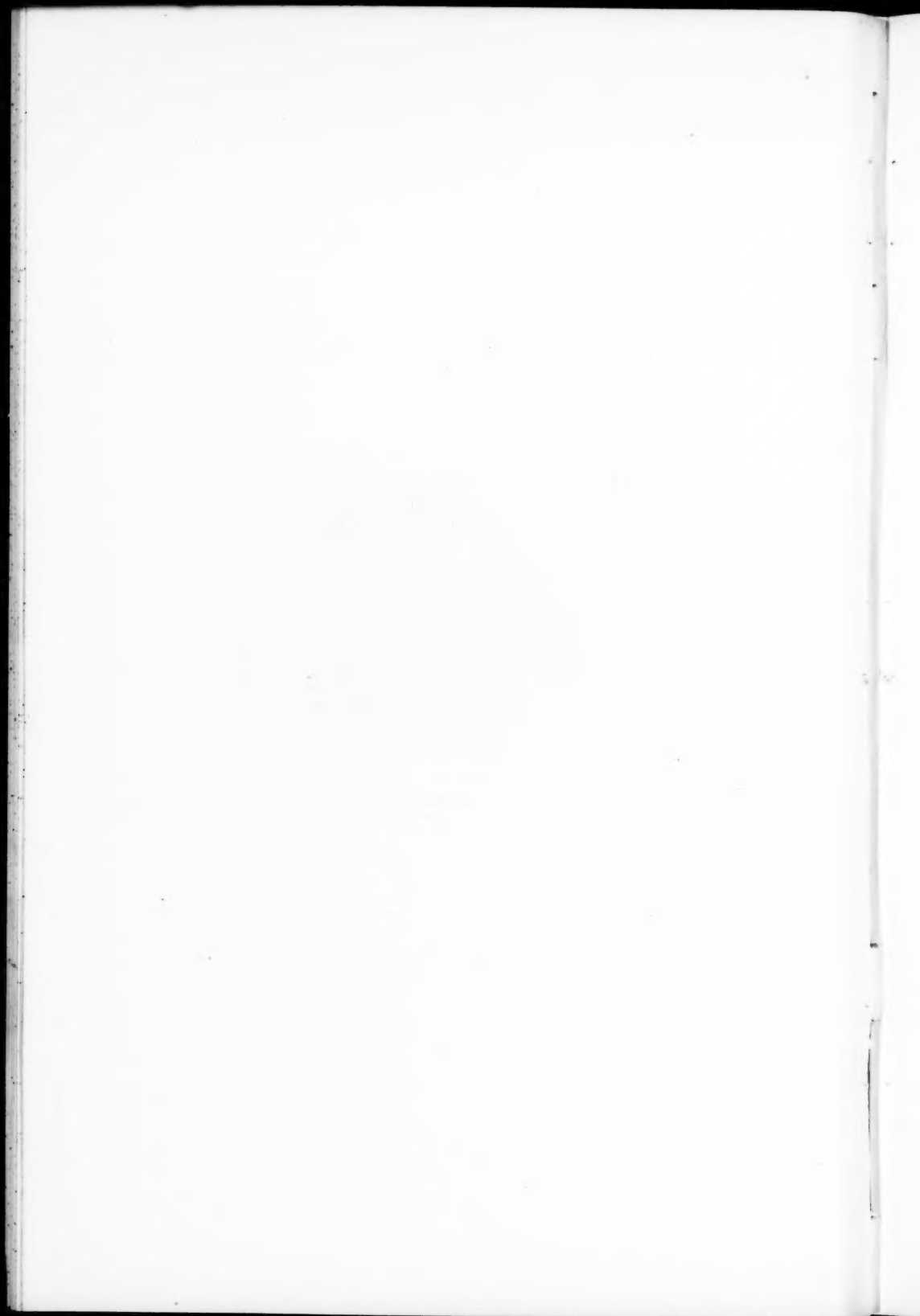


Fig. 4.

As probe is slowly withdrawn, the burr is introduced and the opening is sufficiently enlarged to give a good exposure of the sac.



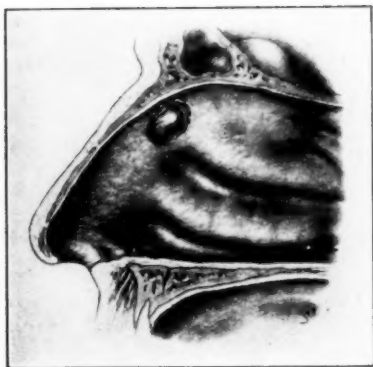


Fig. 5.

Showing the sac exposed.





Fig. 6.



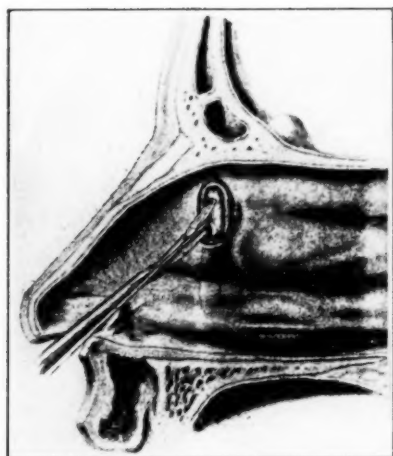


Fig. 7.

Sac is tented through opening with probe, and large piece punched out.

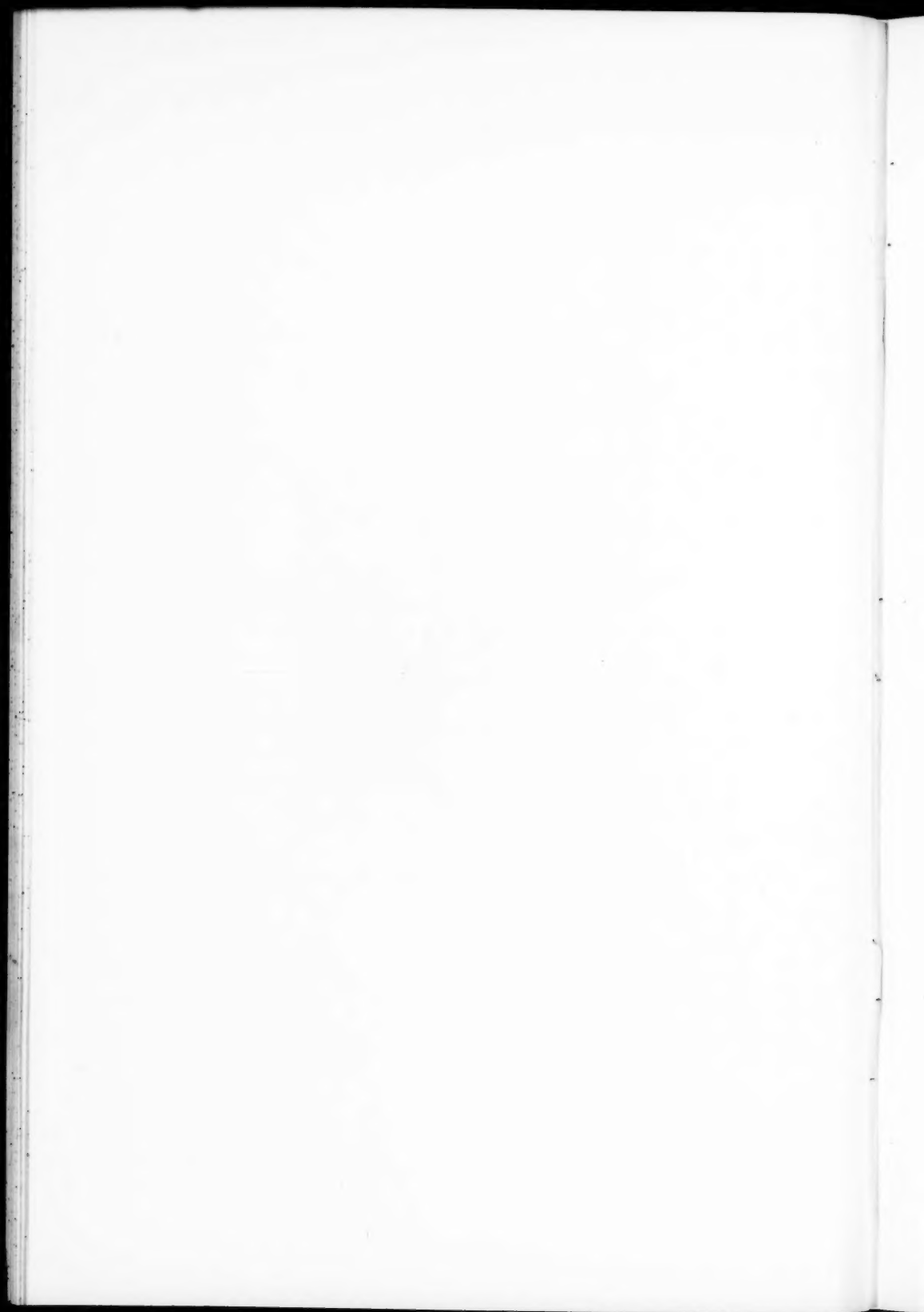




Fig. 8.

Punch forceps with which the opening of the sac may be further enlarged.



III.

STUDY OF REINFORCEMENT OF SOUND BY MEANS OF THE SCHAEFER RESONATORS.*

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In previous papers by one of us (Sonnenschein), "Resonators, with Special Reference of the Schaefer Apparatus" and "Resonators as Possible Aid in Tuning Fork Tests—A Preliminary Report," the description and use of the Schaefer resonators were considered particularly from the viewpoint of the otologist. A consideration of the data given in these papers will show the value of this set of resonators to the otologist in cases of marked impairment of hearing. Many cases of deafness might easily be regarded as complete were it not for the establishment of the contrary through the increase in the loudness of the sounds from tuning forks by means of the resonators. Since their employment is to be strongly recommended, and since the Schaefer resonators have been used by one of the writers for a number of years in his professional work, it seems that the present paper on the sound intensity amplification of this set of resonators will be of much value in showing precisely the sound intensity over and above that of the forks alone.

By way of introduction, a few comments on resonators and resonance may be in place. Resonance makes it possible for periodic force to produce sympathetic vibrations. The periodic force may be blows of a hammer applied at the proper time intervals (what is referred to in physics as the proper phase relation) to a swinging pendulum; it may be the electric voltage or potential applied at the proper time intervals to an electric system, or it may be the acoustic energy applied at the proper time interval by a tuning fork to an air cavity of proper dimensions. In all these cases intense vibrations may,

under the proper conditions, be set up. The hammer blows may cause the pendulum to vibrate with large amplitudes, the electric force may cause a periodic flow of electric current that may become very intense when the electric constants of the circuit are properly adjusted, and in a similar manner the periodic force from a tuning fork may cause intense sounds to be produced at the resonator. So that in all the branches of physics the phenomenon of resonance and the question of resonators are of much importance, and physicists are called upon constantly to deal with them.

To be specific, let us suppose that in the case of sound the periodic force is produced by the vibrations of a tuning fork. This causes sound waves to be generated in the surrounding air, and they cause the second body, called the resonator, to vibrate with the same period as the tuning fork. Thus, the second body may be a tuning fork, a column of air enclosed in a pipe, etc. Under the proper conditions comparatively intense vibrations may be set up in the second body and sounds of particular pitches with greatly increased loudness are produced. In fact, in acoustics this is the chief object of resonators.

As an example of this action of a resonator, we may take the case of the increase in the loudness of the tone given by a tuning fork when it is placed in front of one of the Schaefer resonators which has been adjusted to the pitch of the fork. The fact that the prongs of the fork have not a very great area explains why they are not capable of setting into intense vibration a large amount of the surrounding air because of the slippage of air back and forth around the prongs as they vibrate. In addition, the two prongs of the fork are moving in opposite directions, so that there is interference between the waves emitted by the two prongs. This interference causes a still further reduction in the intensity of the vibrations in the surrounding air. If, however, the tuning fork is held in front of the resonator, then the column of air within will be set into marked vibration, due to the phenomenon of resonance, and an intense radiation of sound energy will occur; provided, of course, that the open end of the resonator is not too small, for in that case the external air would receive a smaller portion of the acoustic energy within the resonator.

In passing, one additional example of resonance may be cited, namely, that of a string: when the latter is vibrating freely there is a very small amount of air set into vibration because of the small superficial area of the string. In addition, the waves thus produced interfere with one another because the condensation on one side of the string interferes with the rarefaction on the opposite side. However, if the string is connected to the walls of a resonator so that the vibrations are communicated directly by the walls to the enclosed air column intensified vibrations are set up in the surrounding air.

These are examples of the intensifying of sound by true resonance. To demonstrate this fact, it would only be necessary to substitute a resonator which responds to a different tone and then no reinforcement of the sound would be observed. These cases should not be confounded with those of forced vibrations with a corresponding increase in loudness. Thus, a table top will cause an intensification of sound given off by all the forks of lower pitch, and tones which might otherwise be inaudible are capable of being heard by a large audience. The intensification of the sound is due, of course, to the surface of the table setting into violent vibration a large volume of surrounding air.

It is important to remember that the resonator receives the energy necessary to set it into violent vibration from the sounding body acting as the periodic force—for instance, that of the tuning fork. Therefore, since the increased loudness of the emitted sound is due to the resonator means that more sound energy is radiated per unit time into the air, it follows that the sounding body (the tuning fork) must lose its energy of vibration more rapidly when a resonator is present than it does without the resonator. That this is so can be easily demonstrated; for example, a 512 d. v. fork was heard 30 seconds when placed close to the ear and was heard only 20 seconds when the resonator was used. Again, a 256 d. v. fork was heard 120 seconds without the resonator and only about 90 to 100 seconds with the resonator. Lord Rayleigh cites a more convincing case observed by Koenig: "Thus, without a resonator a fork of 256 double vibrations sounded in a satisfactory manner for about 90 seconds. A resonator of adjust-

able pitch was then brought into proximity, and the pitch, originally much graver than that of the fork, was gradually raised. Even when the resonator was still a minor third below the fork there was a slight diminution observed in the duration of the vibratory movement. As the natural tone of the resonator approached nearer to that of the fork, this diminution in the time became more pronounced up to the immediate neighborhood of unison; but at the moment when unison was established the sound was powerfully reinforced; but this exaggerated intensity fell off rapidly and the vibration died away after eight to ten seconds. The pitch of the resonator being raised, the duration of the vibrations gradually recovered its original value of about 90 seconds."

These data are important to remember in the use of resonators, for if the tones are louder one might expect that they would be heard a correspondingly longer time. The above data show this not to be the facts, but on the contrary they should be heard by a normal ear a shorter time interval with the resonator than without it. In the case of persons with impaired hearing consistent results should be observed with any given patient at one pitch. Results would be inconsistent when considered as a whole, for some patients would hear longer with the resonator than without it, while the reverse should be expected for patients with a different impairment of hearing. The findings at various pitches for any one patient need not be consistent, inasmuch as the impairment is not the same at different pitches. We believe this will explain satisfactorily some of the data (which may appear inconsistent) observed and reported by one of the present writers. Hence, if it is desired to make any observations of the duration of hearing with the resonators consistent results will be obtained when a comparison is made only with the time heard by normal ears with the resonators. No effort should be made to obtain a comparison between the times heard with and without the resonator.

Experimental Results of Intensity Amplification.—The method of employing the Schaefer resonators, a photograph of which is shown, has been described in the papers to which reference has already been made. This method consists in attaching a rubber tube to the closed end of the resonator and

then connecting with the patient's ear by means of a hard rubber olive tip. The vibrating fork is held by the examiner before the open end of the resonator and the sound is reinforced. The amount of accentuation, however, will be different for the patient than for the examiner because both persons are not listening to the sound in the same manner. In order that the examiner may not draw doubtful conclusions because of this fact, the following three groups of tests were made:

GROUP I. AMPLIFICATION AS PERCEIVED BY THE EXAMINER.

The forks were excited by a rubber stopper having a brass core about 2 cm. long and 1 cm. in diameter. To obtain a uniform force the stopper was attached to a string 48.5 cm. long and the opposite end suspended from a suitable arm. The cork was pulled aside certain definite distances and allowed to swing freely through a measured arc. The forks were held at the bottom of the arc so that the force of the impacts could be calculated.

Tests for the purpose of determining the amplification of the sound as heard by the examiner were made in the following manner: A current from an audion oscillator was passed through a telephone receiver, the frequency of the current having first been brought into unison with that of the fork. A galvanometer was used to measure the current necessary for the receiver to generate a tone of the same loudness as that given forth by the resonator when the fork was held before the open end (a in Table I).

In this instance the receiver diaphragm and the open end of the resonator are the same distance from the examiner's ear (usually 60 cm.). In the second part of the test (b in table I) the receiver and fork were placed at the same distance (usually 12.5 cm.) from the ear and the current noted that caused the tone from the receiver and the fork to sound equally loud. Care was taken to strike the forks with the same force in both parts of the test. In passing, it should be noted that the forks of different pitches in some instances had to be struck with different forces in order to obtain the desired comparison. The particular forces necessary for this purpose were determined by trial and depended on both the receiver characteristics and the dimensions of the forks, as

shown in Table V. The sensitivity of the galvanometer also entered into the selection of the forces.

The square of the ratio of the current through the receiver when the resonator was used to that when the resonator was not employed gave a direct measure of the relative intensity of the tone of the tuning fork when used with and without the resonator. In other words, the square of this current ratio will show the intensity reinforcement of the sound by the resonator at the moment when the fork was placed before the opening. This, of course, is the maximum reinforcement.

It may be said, parenthetically, that the square of the current ratio is sought because the sound intensity produced by the receiver diaphragm is proportional to the square of the electric current.

TABLE I.
RESONATOR TESTS.

Test No. I.—Amplification of sound as it appears to the examiner.

Ratio of current with closed resonator (not connected with ear) and that with fork at constant distance from examiner's ear.

(a) Test with resonator, fork and telephone receiver.

(b) Test with fork and receiver only.

N. B.—Type Western Electric 144 telephone receiver used in all tests.

Fork used		Distance of receiver and resonator from ear	Distance of swing of rubber weight against fork	Velocity at time of impact against fork	Length of resonator	Intensity amplification as it appears to examiner
d sharp	(a)	25 Cm.	4.5 Cm.			
154 v. d.	(b)	7 Cm.	4.5 Cm.	20 Cm. per sec.	553 mm.	15.5
c1	(a)	60 Cm.	6 Cm.			
256 d. v.	(b)	12.5 Cm.	6 Cm.	27 Cm. per sec.	327 mm.	96.5
g1	(a)	60 Cm.	9 Cm.			
384 d. v.	(b)	12.5 Cm.	9 Cm.	40 Cm. per sec.	213 mm.	222
(small fork)	(a)	60 Cm.	45 Cm.			
a1	(b)	12.5 Cm.	45 Cm.	185 Cm. per sec.	185 mm.	273
435 d. v.	(a)	60 Cm.	20 Cm.			
c2	(b)	12.5 Cm.	20 Cm.	90 Cm. per sec.	145 mm.	204
512 d. v.	(a)	60 Cm.	45 Cm.			
g2	(b)	12.5 Cm.	45 Cm.	185 Cm. per sec.	96.5 mm.	62
768 d. v.	(a)	60 Cm.	45 Cm.			
c3	(b)	12.5 Cm.	45 Cm.	185 Cm. per sec.	64 mm.	63
1024 d. v.	(a)	60 Cm.	45 Cm.			
	(b)	12.5 Cm.	45 Cm.			

Table I shows the results that were obtained for the four resonators in this group of tests. It will be observed that the reinforcement of the sound varies from 15.5 to 68 and that the efficiency of the resonators diminished rapidly for both the higher and lower pitched resonators. The maximum intensification is obtained at the medium pitches, reaching a value of 273 for the a^1 (435 d. v.) fork.

GROUP II. AMPLIFICATION AS PERCEIVED BY THE PATIENT.

For this series of tests the forks were excited as above described and held before the open end of the resonator while a small rubber tube about 75 cm. long attached to the closed end of the resonator was connected with the ear by means of an olive tip. A tone of the same pitch as that of the fork was given forth by the receiver placed in contact with the ear. The loudness of this tone was made equal to that of the resonator and the corresponding current noted. In the second part of this test the fork was excited with the same force as before and then held in close proximity to the observer's ear. The loudness of the tone was carefully noted, and immediately afterwards the telephone receiver, with a current of the proper frequency passing through it, was placed against the ear. Repeated comparisons were made, and when equality of the two tones was reached the receiver current was again measured. The square of the current ratio in the two instances gave the intensity amplification produced by the resonator when used in this manner.

Table II shows the same results that were obtained with the four resonators. It will be observed that the amplification increases from 2.9 for the highest pitch to 44 for the g^1 (364 d. v.) and then decreases to 10.3 for the d sharp (154 d. v.) fork.

These data are in accord with the statements made by Schaefer in one of his papers in which, however, he gave no measurements to confirm his assertions. It may also be remarked that no data regarding the intensity amplification of sound by resonators have been found by us in either medical or physical references.

TABLE II.

RESONATOR TESTS.

Test No. II.—Amplification of sound as it appears to the patient.

Ratio of current with

(a) Receiver held against ear and resonator connected with ear via rubber tubing, and

(b) With receiver against ear and fork held close to ear.

N. B.—Type Western Electric 144 telephone receiver used in all tests.

Fork used		Distance of rubber weight against fork	Velocity at time of impact against fork	Length of resonator	Intensity amplification as it appears to patient
d sharp	(a)	10 Cm.	47 Cm. per sec.	553 mm.	10.3
154 d. v.	(b)	10 Cm.			
c1	(a)	6 Cm.	27 Cm. per sec.	327 mm.	38
256 d. v.	(b)	6 Cm.			
g1	(a)	9 Cm.	40 Cm. per sec.	213 mm.	44
384 d. v.	(b)	9 Cm.			
(small a1 fork)	(a)	45 Cm.	185 Cm. per sec.	185 mm.	25
435 d. v.	(b)	45 Cm.			
e2	(a)	20 Cm.	90 Cm. per sec.	145 mm.	10
512 d. v.	(b)	20 Cm.			
g2	(a)	45 Cm.	185 Cm. per sec.	96.5 mm.	9
768 d. v.	(b)	45 Cm.			
c3	(a)	45 Cm.	185 Cm. per sec.	64 mm.	2.90
1024 d. v.	(b)	45 Cm.			

GROUP III. INTENSITY AMPLIFICATION IN UNCONFINED OPEN SPACE.

The above tests were made in a room, and it was desired, as a further experiment, to determine the amplification ratio in an open, unconfined space. This third condition of use is quite different from the two just described, and for this reason it is to be expected that the findings would be greatly modified. In an unconfined space there is a direct radial propagation outward of the sound energy at distances large compared with the dimensions of the forks and resonators. Under this condition there are no reflections from neighboring

surfaces, and furthermore there are no standing waves to contend with. Under these conditions the sound intensity would vary inversely as the square of the distance from the source.

The procedure, then, was to obtain a direct comparison between the greatest distances a fork could be heard (a) without and (b) with the resonator. The square of the ratio of these distances gives a direct measure of the intensity amplification. Care was taken to excite the fork with the same force in the two instances. In (a) the fork was struck and the distance noted at which the tone was just audible. In (b) the fork was struck and held before the resonator and the distance again noted at which the tone was just audible. The square of the ratio of these two distances gave the desired result.

The findings under these conditions are recorded for the four resonators in Table III. This method of use also shows that the resonators are much more efficient for sound reinforcement at the lower pitches than at the higher ones, but that the decrease at the lowest pitches is very much less marked under the present condition than under the two preceding ones.

The variation of the efficiency of the resonator to reinforce sounds of different pitches is a phenomenon familiar to physicists. The main reason for the reinforcement, as has been pointed out earlier in the paper, is because of the proper phase relation of the pressure due to the fork with that due to the resonator. That is, the phase relation must be favorable in order that a reinforcement may occur. When the wave length of the tones becomes comparable with the dimensions of the fork and with those of the resonators, then the phase relations deviates from the proper ones, and thus large intensification by a resonator of the tones of the higher pitches becomes impossible of attainment.

The interference of the sound in the air surrounding the forks (already referred to in the paper) is more marked for the forks of the lower pitch than those of higher pitch. This fact is responsible to a large extent for the decrease in the intensity amplification of the resonators of a lower pitch. Hence, the phase relations at both lower and upper extremities of possible resonance due to sound resonators become the determining factors in limiting the intensity of the sound.

TABLE III.

RESONATOR TESTS.

Test No. III.—Amplification of sounds in unconfined space.

Forks struck with rubber hammer and distance noted at which they were heard

(a) without resonator

(b) when held near corresponding resonator.

Resonators were used at height of 70 cm. from the ground.

(One control test at height of 600 cm. from ground showed no material difference in amplification.)

Fork used	Distance heard (a) without resonator	Distance heard (b) with resonator	Length of resonator	Intensity amplification
(1) A 108 d. v.	16.5 Cm.	1550 Cm.	786 mm.	8900
(5) d sharp 154 d. v.	30 Cm.	3100 Cm.	542.5 mm.	10700
(2) c 128 d. v.	19 Cm.	1450 Cm.	668 mm.	5800
(4) c1 256 d. v.	52.5 Cm.	4745 Cm.	330 mm.	8225
(5) e1 320 d. v.	136.5 Cm.	4405 Cm.	257.5 mm.	1047
(6) g1 384 d. v.	53.5 Cm.	2408 Cm.	213 mm.	1460
(7) (small a1 fork) 435 d. v.	10 Cm.	330 Cm.	185 mm.	1095
(8) c2 512 d. v.	140 Cm.	4067 Cm.	145 mm.	845
(9) g2 768 d. v.	1272 Cm.	5156 Cm.	96.5 mm.	16.6
(10) c3 1024 d. v.	2350 Cm.	5209 Cm.	64 mm.	5
c2 512 d. v. CONTROL TEST Resonator 600 Cm. above ground.	143 Cm.	4600 Cm.	145 mm.	1030

TABLE IV.

RESONATOR TESTS.

Comparison of intensity amplifications as they appear to the examiner, the patient and in open unconfined space.

Fork used	Amplification as it appears to examiner	Amplification as it appears to patient	Amplification in open unconfined space
d sharp	15.5	10.3	10700
154 d. v.			
e1	96.5	38	8225
256 d. v.			
g1	222	44	1460
384 d. v.			
(small al fork)			
435 d. v.	273	25	1095
c2	204	10	845
512 d. v.			
g2	62	9	16.6
768 d. v.			
c3	68	2.85	5
1024 d. v.			

A final table is given below, the purpose of which is to bring together for direct comparison the intensity amplification of the four resonators when tested according to the three methods outlined above. The reinforcement of all tones is greatest in the open, unconfined space, is consistently the least as observed by the patient and is intermediate as heard by the examiner under actual testing conditions. Since the intensity amplification is much greater when the resonators are used in the manner as tested in the unconfined space, it might be advantageous to make use of this fact in testing deafness. This could be done merely by comparing the distances that a fork, when sounded before a resonator of the proper pitch, could be heard by the normal and the defective ears. The ratio of these distances, when squared, will show the intensity amplification required for the deaf person to hear compared with that required by a normal ear.

Finally, it may be pointed out that a set of standing waves are present in the rubber tube leading to the ear and attached to the resonator. The distance between the nodes and loops within the tube will be determined by the pitch of the tone. These loops and nodes could be detected with the ear when the fork was sounded before the resonator and the tube compressed at different places. Compression at a node (zero displacement of the air) did not change the loudness of the tone.

but compression at a loop (maximum displacement of the air) caused a decided change in the intensity of the tone as observed by the ear in the vicinity of the resonator.

TABLE V.

DIMENSIONS OF PRONGS OF FORKS USED.

		Width	Length	Thickness
A		1.89 Cm.	23.75 Cm.	0.8 Cm.
108 d. v.				
c		1.9 Cm.	30.3 Cm.	1.5 Cm.
128 d. v.				
e1		1.45 Cm.	16.15 Cm.	0.8 Cm.
256 d. v.				
e1		1.4 Cm.	12.6 Cm.	0.6 Cm.
320 d. v.				
g1		1.5 Cm.	11.7 Cm.	0.65 Cm.
384 d. v.				
a1		0.9 Cm.	7.7 Cm.	0.3 Cm.
435 d. v.				
Weighted:	Size of weights	1.7 Cm. wide		
c2	Fixed weight	2.8 Cm. long		
512 d. v.		1.8 Cm. thick		
g2				
768 d. v.				
c3				
1024 d. v.				
	Weights	1.65 Cm. wide		
e1 weighted	(adjustable)	1.45 Cm. long		
Dis. 154 d. v.		2.55 Cm. thick		
		1.55 Cm.	14.5 Cm.	0.65 Cm.

Now, when the olive tip is placed in the patient's ear it probably acts to some extent as though the end of the tube were closed (but not entirely, for the meatus is much larger than the hole in the olive tip). This would tend to make the end of the tube act as a node of displacement (or a loop of pressure), whereas if the tube were open the end would act like a loop of displacement (or a node of pressure). For these reasons at 512 d. v. we made a measurement of the amplification ratio first with the olive tip placed at a loop and next at a node of displacement. These positions were determined with the olive tip not inserted in the meatus. In the first case the intensity amplification was 10 and in the second case 11.5 as observed by the method of test used on the patients. This difference of about 10 per cent is within the limit of error of the observation reported herein, so that we may conclude with much certainty that the length of the rubber tube is, physically speaking, not a factor of much importance. It is advised, however, that an excessive length of tube be avoided, inasmuch as it changes the pitch of the resonator to a small degree. For this reason the exact setting of the resonator for

any particular fork should be determined under actual testing conditions.

CONCLUSIONS.

1. The sound intensity amplification of the (Schaefer) resonators depends on the manner in which they are used. The maximum value of this amplification as observed, firstly, by the examiner, is 273; secondly, by the patient, 44, and thirdly, as it appears in unconfined space, 10,700.

2. The efficiency of the Schaefer apparatus as a resonator decreases rapidly for the higher pitched tones. The same is true at the lower pitched ones except when tested in the open, unconfined space.

3. The resonators do not increase the total energy given forth by the tuning fork, but permits this energy to be dissipated at a greater rate.

4. The decrease of the efficiency of the resonator with rising pitch is due to the unfavorable phase relation of the air pressure produced by the tuning fork with that caused by the resonator.

5. Inasmuch as the resonators cause tones to be produced of greatly reinforced intensity, they might be of considerable value from a clinical viewpoint. This is particularly true for the set of four Schaefer resonators, since there are given herein the actual magnitudes of the intensity amplification. As noted in previous papers, the Schaefer resonators lend themselves well to practical purposes, since they cover a comprehensive range, are comparatively cheap, compact and easily manipulated.

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IV.

REGIONAL ANATOMY OF THE TEAR SAC.

BY JAS. M. PATTON, M. D., F. A. C. S.,

OMAHA.

Any consideration of the regional anatomy of the tear sac must recognize the importance of the bony lacrimal fossa and its continuation, the nasolacrimal canal. An examination of a considerable number of dried skulls shows rather marked variations of structure. For example, the anterior and posterior crests may be comparatively flat and the fossa correspondingly shallow, or they may be so pronounced as to make the fossa very deep, and in some instances may even give it the appearance of an incomplete cylinder. This, of course, is of little significance except that where we find such abnormal conditions in the fossa we are liable to find abnormalities in the bony lacrimal canal. For instance, the opening from the fossa may be much smaller than normal, or it may be irregular in shape and position. The makeup of the floor of the fossa is of greater interest from a practical standpoint. If the lacrimal bone predominates, as shown in Figure 1, the floor is fragile, easily broken down, and the fossa is more likely to be at least partly covered on the nasal side by the anterior tip of the middle turbinate. Where the ascending process of the maxilla predominates, as shown in Figure 2, the floor of the fossa is very dense and in many cases marked difficulty will be experienced either in passing from the sac through into the nose, as in the Wiener operation, or in coming from the nose through into the sac, as practiced by Yankauer and others. In an examination of about one hundred and fifty orbits, we found that sixty-eight were of the porous type. In the remaining forty-seven the maxillary process predominated. I was unable to judge from the contour of the bony skull in every case as to just what the condition of the fossa would be, but it was quite evident that where there was a marked development of the heavy bones of the face, jaws, fron-

tal prominences, etc., that the maxillary element of the fossa was more likely to predominate, while in the lighter skulls the lacrimal element was more in evidence.

In operating on these cases we should remember that the lacrimal sac does not come directly in contact either with the bony fossa or with the overlying muscles, but is partially inclosed by an extension of the periorbita, which on the nasal side lines the fossa and at the posterior lacrimal crests divides to form the lacrimal fascia, which is rather firmly stretched, roofing the fossa between the two crests, and may be mistaken for the sac itself by inexperienced operators. There is a narrow space between the sac and this fibrous envelope occupied by vessels and lymphatics. According to Whitman, the canalicule never join till after passing the fascia lacrimals and the so-called common canaliculus is in reality a diverticulum from the sac.

It is the opinion of our anatomical confreres that the flattening of the upper extremity of the sac is due to compression by the fascia lacrimals, aided to a certain extent by the action of the pars lacrimalis muscle (Horners) and the medial palpebral ligament, the latter forming an excellent landmark for the location of the upper third of the sac. In any case, instead of the lacrimal sac being somewhat larger than the diameter of the bony canal—which it undoubtedly is in some pathologic states—it may have more of the shape of an irregular cone with its base at the bony opening of the canal, as Shaffer has shown, from his reconstruction, there may be marked variations from the so-called normal with constrictions, angulations and diverticula of both the bony and membranous tract, undoubtedly accounting for some of our failures in attempting to restore drainage through regular channels.

Figure 3 from Whitman is of interest and shows that the axis of the canal is inclined backwards approximately fifteen to twenty-five degrees from the vertical axis of the face. The direction from the inner canthus is toward the space between the anterior border of the first and third molar teeth. It also shows in the insert the relation of the canals to the antra, with the so-called lacrimal protuberances.

The nasal opening of the canal varies considerably as to size and location. The "protecting valves" are simply folds of the

lining mucosa and without any direct valve action. According to Whitman, the mucosa is continued from the nose to the palpebral opening of the canaliculæ and convinces a number of careful observers that the large majority of lacrimal infections are of nasal origin.

In preparing for a dacryorhinocystotomy we may well consider the probable character of the bony lacrimal fossa, whether it is fragile or dense, the *facia lacrimals* and its overlying medial palpebral ligament, the probable size and direction of the nasal lacrimal duct with its point of emergence beneath the inferior turbinate and the probable presence or absence of overlying anterior ethmoidal cells. The recognition of these anatomical conditions may help us to decide as to which of a number of excellent operative procedures is best suited for the correction of the symptoms we are attempting to relieve.



Fig. 1.

Left orbit showing lacrimal bone occupying nearly all of lacrimal fossa. Bone porous. Easily broken down.

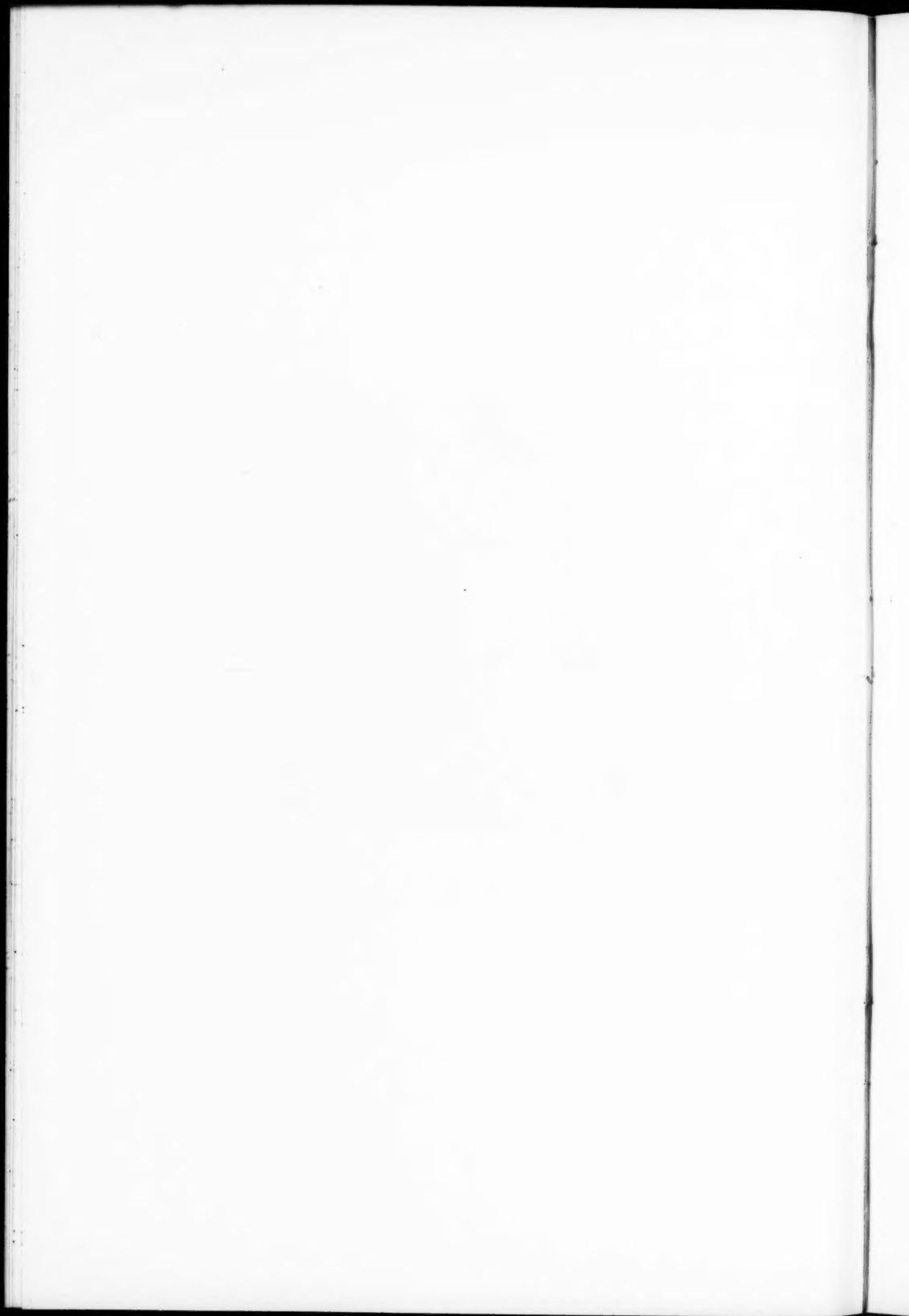




Fig. 2.

Left orbit showing floor of fossa almost entirely made up of ascending process of maxilla. Floor very dense and thick. Note heavy supraorbital margin.

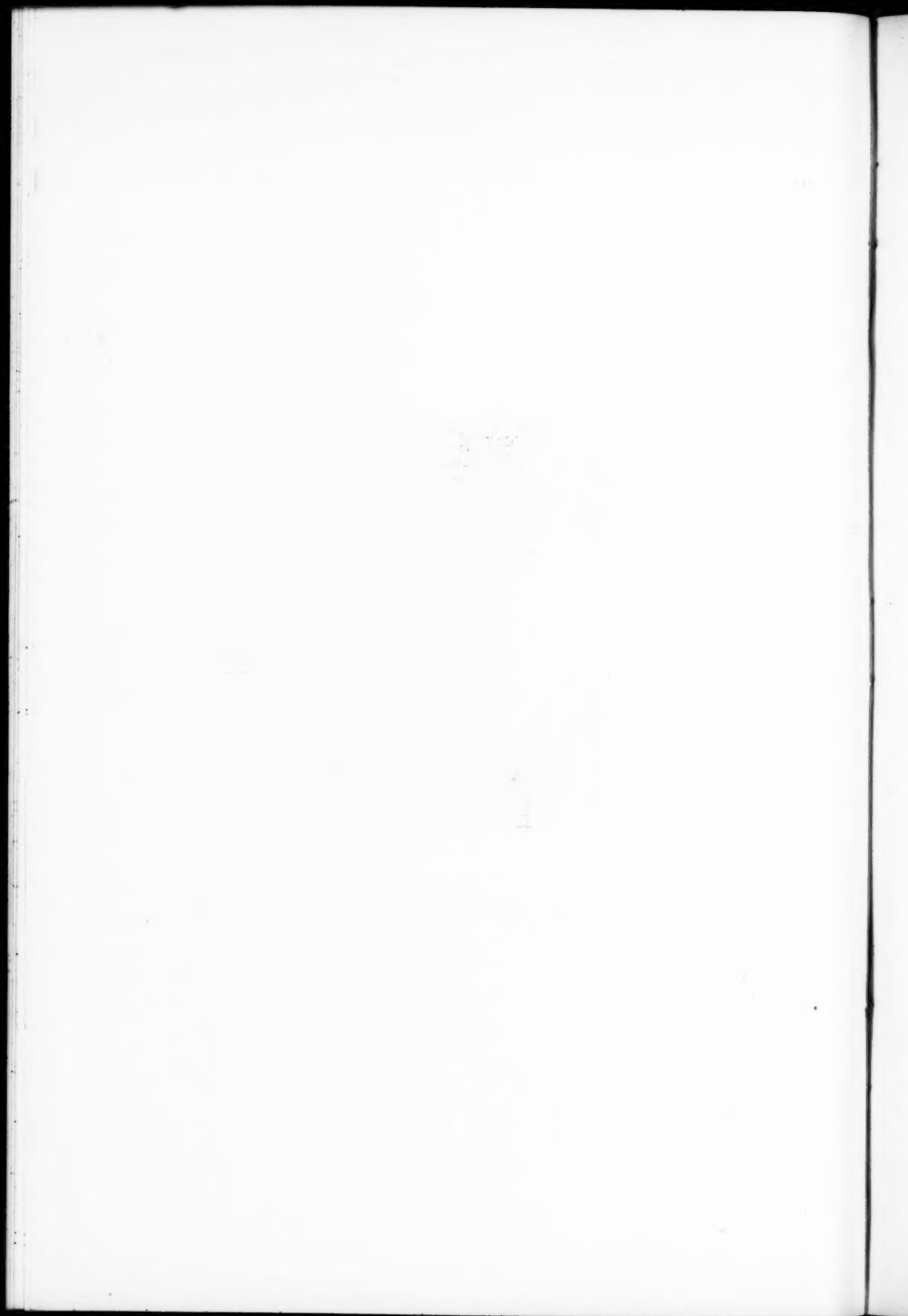
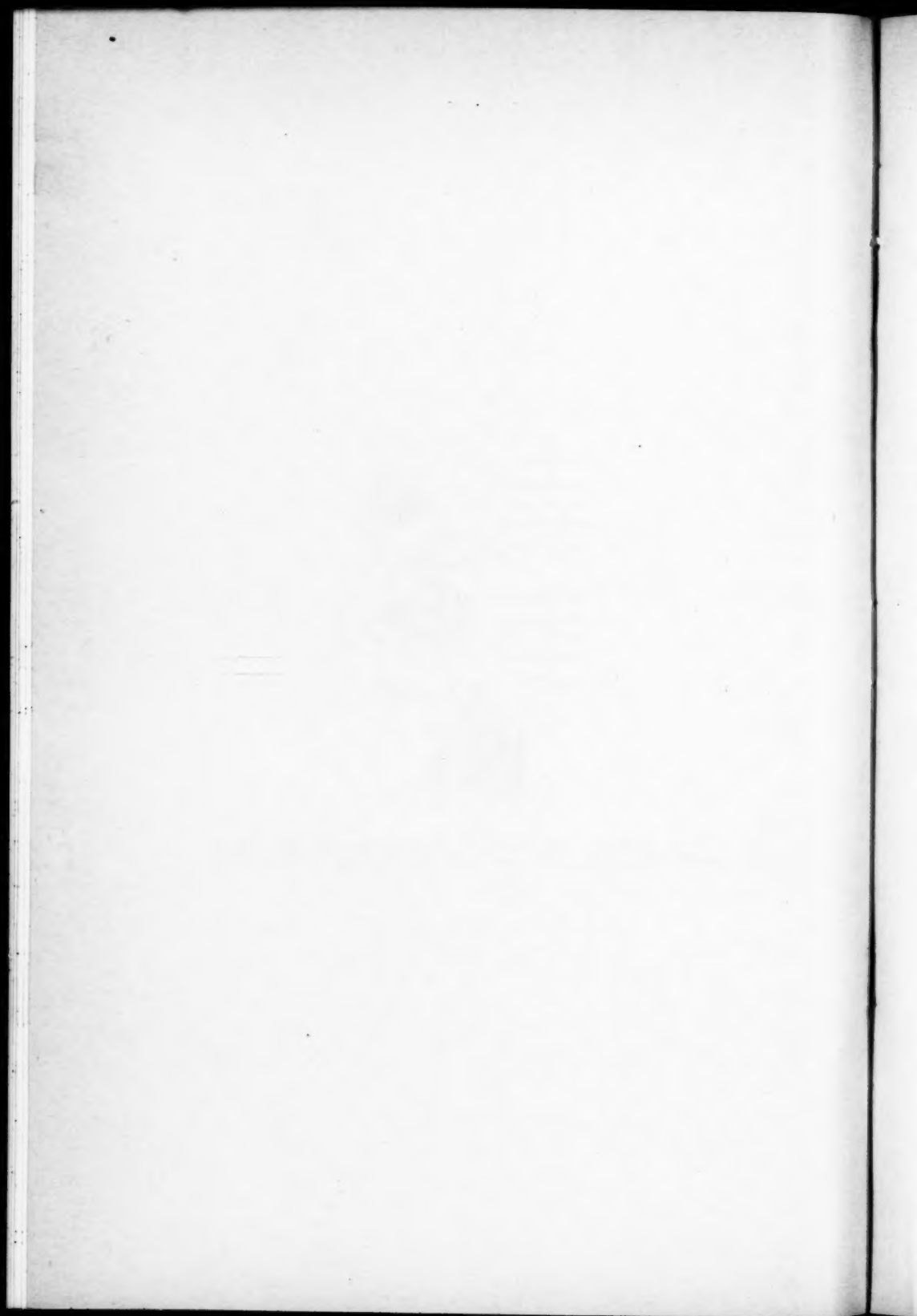




Fig. 3.

From Whitman, showing angle of nasal lacrymal duct and in insert cross section with relation of nasal lacrymal ducts to antra.



V.

INDICATIONS, CONTRAINDICATIONS AND PREPARATION FOR DACRYOCYSTORHINOSTOMY.

BY DR. RALPH A. FENTON,
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The operation of dacryocystorhinostomy is only to be considered in cases where simpler means of treatment of tear sac suppuration have not sufficed. Indications for it must be based upon very careful anatomic study and, as the previous paper has demonstrated, the anatomy may be very intricate. The nose should always be examined both before and after careful shrinkage by adrenalin, and those who do only eye work or nose work should hesitate to select this procedure without consultation by a colleague prepared in the other branch.

A few diagrams, trespassing a little upon the field which Dr. Patton has covered with such admirable detail, will perhaps clarify the matter of indications and contraindications.

As opposed to excision or obliteration, the first indication (Fig. 1) is for speedy, radical cure. Dangers to be avoided include those arising from a pus focus that cannot be kept clean; septic absorption from the sac itself, a closed cavity often without drainage for weeks at a time; consequent iritis, endocarditis, arthritis and the like. Locally, there is constant danger of *ulcus serpens* or other corneal involvement; and, due to drainage into the nose, we may have destruction of normal epithelium, with septal ulcerations and even *ozena*; or, still further down, we may find lateral pharyngitis, or recurrent tonsillitis and laryngitis. Indeed, an ethmoiditis or maxillary antrum involvement is not infrequently associated with chronic dacryocystitis.

The second indication (Fig. 2) is based on the need for a clean eye. No intraocular operation of any moment may be done in the presence of severe suppuration. The pus may be temporarily shut off by ligation of the canaliculi, an uncertain

makeshift when more modern means such as dacryocystorhinostomy are available. Chronic conjunctivitis, blepharitis, fissures and dermatitis are one or all present, and at all times the hazard of recurrent phlegmon and its extension into erysipelas must be reckoned with—an especial danger in those with thin and florid skin.

Third (Fig. 3) comes the need for restoration of physiologic function. The proposition that gradual lessening in the amount of tears secreted will follow excision of the sac is probably based upon the observation made by many operators that cessation of chronic conjunctival irritation has taken place at the same time. In the presence of chronic conjunctivitis a constant stimulus to lacrimation naturally remains, and may even suggest the removal of the lacrimal gland if all other measures have failed. Further interferences with physiologic function come by reason of diverticula of the sac, often extending far out into the cheek. Cicatricial stenoses may have arisen from injudicious treatment, overstretching, or from altogether false passages, particularly in those cases mentioned by Schaefer where duct and sac join at right angles. Anywhere along the duct bony stenosis may occur, with new bone formation and complete occlusion. Obliteration or excision cannot, of course, restore, but must destroy the further physiologic use of these structures.

Coming now (Fig. 4) to the need for good cosmetic results: Successful dacryocystorhinostomy will avoid excessive tearing with its entailed skin irritations. People who are obliged to be out of doors a great deal become very much annoyed by the necessity for wiping the eye, by clouding of glasses, and by the dermatitis that frequently arises. Moreover, by selection of appropriate type of operation, the external scar may be avoided or kept practically invisible.

With reference to the type of operative technic selected, three essentials must be remembered:

- a. The nose must be roomy, or must be made so;
- b. There must be one functioning canaliculus;
- c. There must be enough of the sac left to form a good drainage channel.

Unless these things are assured, it is very probable that failure will attend any attempt to perform the various types of dacryocystorhinostomy.

Turning to the contraindications, we may first regard the occlusions of infancy, ordinarily disappearing unaided with the lapse of time or after a single probing. These things get well and do not call for extensive invasion of the rapidly growing bones of the face. Similar conservatism should attend the much more virulent disorders of old age, by reason of the brittleness of the bones, as well as danger to the lungs and heart from anesthesia. Here palliation has its proper field. It is of course possible, even with most careful instrumentation, so to fracture the orbitonasal wall that invasion of subcutaneous planes may occur, bringing on erysipelas or cellulitis vastly dangerous to those along in years.

Examining the ocular contraindications (Fig. 5), we find obliteration of the canaliculi, fibrous shrinkage of the sac and caries of the bony wall, resulting from improper probing as well as from syphilis. Existence of lupus or of cancer, even though slow growing, should in this region be deemed an absolute contraindication.

Cardiovascular, renal or diabetic conditions, and of course tuberculosis or syphilis, must guide the decision for persons requiring general anesthesia. Wise policy will suggest the use of palliative treatment while the cure of the general disorder is awaited.

Keloidal tendencies in the colored race must be considered before any operation is chosen that will entail going through the skin. Persons with thin, florid skin, readily chapped, must be watched for erysipelas. Others, with pyodermic tendencies—acne, boils, impetigo and the like—must lead us to consider well the danger in permitting such a surface infection to invade the loose fascial planes of the orbitonasal region.

Considering now the nasal contraindications (Fig. 6), which may in many cases be remedied by operation, we may first examine the overlying groups of ethmoid cells. In the diagrams many structures at different depths are drawn in side by side—unciform, agger nasi or bullar cells, and cystic degenerations of the middle turbinate. These structures must be carefully worked out, a task often facilitated by radiographs.

In doubtful cases bismuth is sometimes injected into the sac, but this is rarely needed. The large middle turbinate which interferes with access to the lacrimal bone, or to the crest of the ascending process of the superior maxilla, must be reduced in volume or resected in part—measures occasionally needed for the inferior turbinate as well.

High septal thickening which impinges against the middle turbinate often completely prohibits access to the lacrimal sac. Occlusive or even moderately narrowing anterior deviations, whether cartilaginous or involving the crest, should be done away with also. Thickening of the ascending process of the superior maxilla frequently protrudes very markedly into the nose, and it is extremely difficult, without removal of this thickening as a first step in the operation, to get anywhere in the vicinity of the sac in such a way that it may be inspected and cut off or even seen when pushed into the nasal opening.

The contraindication of pus in the nasal operative field is most important: pus flowing up and out from the maxillary antrum, down from the frontal sinus and forward from the anterior ethmoids, streaming across the middle turbinate and accumulating along the floor of the nose. Operation through such a field with any intranasal invasion of the lacrimal tract is surgically rather undesirable, in spite of high local resistance and the good drainage usually present. Nasal polypi, proceeding from the antrum, ethmoids or frontal, are not only obstructive to the field, but usually mask a flow of pus that needs clearing up. Papillomatous or "bleeding polypi" must entail the same careful reservations as to intranasal procedures which they invite when found near the eye, externally. Syphilitic or tuberculous intranasal disease also forbids the choice of dacryocystorhinostomy.

With respect to all preliminary nasal operations, it may be said that if such surgical preparation is easy and readily applicable, it should certainly be done at least two to four weeks prior to the time set for the tear sac operation. If this is not done, if the second operation comes too close to the first, there is very often more or less serious interference by crusts or granulations with proper drainage of the nasal aspect of the wound. Opened ethmoid cells, in particular, should be cut well back out of the field of the tear sac procedure.

As to the preparation, we should consider the general medical aspects of the patient, especially when advanced in years. Blood pressure should be reduced and albuminuria and acidosis forestalled by proper treatment and dietary regulation. We must also avoid the onset of dangerous renal complications while these people are in the hospital. Duration of the stay in hospital is sometimes very limited, and it is quite possible that an occasional serious complication reported might have been avoided by keeping such a patient quiet under hospital observation for a longer period. The time will naturally vary with the extent and nature of the operative procedure.

Hypodermic use of morphin, usually with atropin, customarily precedes general or local anesthesia for this group of operations.

Preparation of the eye varies of course with the type of operation and the choice of the operator. It might be said that thrice daily irrigation with hot normal saline solution is sufficient, and the sac should be washed out once daily with a minimum of trauma. This means that introduction of a long canula, or of a canula with sharp ends from which the plating has been worn, should be avoided. Most clinicians seem opposed to the continuance of attempts at probing when dacryocystorhinostomy has been decided upon. For control of pus during the days of preparation, mercurochrome, 2 per cent, or 1/4,000 bichlorid of mercury have been used. Argylol and other silver albuminates are avoided in most clinics, due to the fact that in certain cases the fragility of the sac permits easy escape of the silver beneath the skin with disastrous staining. A weak bichlorid ointment is helpful in cases which are prone to blepharitis, and may well be used in all cases for two or three nights prior to operation.

In the nose, especially when dealing with recently healed suppurative conditions, gentle washing with bloodwarm plasma or saline solution may be practiced twice a day. If much force be used, traumatism may result; a swelling of the nasal mucosa which will defeat the whole purpose of the washing. A mild chloretone oil, perhaps 1 per cent, in heavy liquid petrolatum, dropped into the nostrils, will allay a great deal of minor irritation. Chronic infective processes in the nasal

passages may be held somewhat in abeyance by dropping in 2 per cent mercurochrome or 25 per cent argyrol solution.

For immediate preparation the same mercurochrome or 3 per cent tincture of iodine may be painted over the nasal aspect of the region of the sac prior to the opening of the mucosa. However, in view of the careful washing out of the sac itself at the time of operation, and the fact that these antiseptics are often in use during the progress of the operation preliminary intranasal swabbing is not strictly required.

For skin preparation most clinicians seem to prefer gentle soap and water washing, drying and very careful employment of benzine and weak iodine solution. Care must be exercised to avoid conjunctival irritation.

In all these details it may be said that the question of individual choice and the question of the experience of the clinician should have the first influence.

Relative to indications or contraindications, it may well be stated that this is not a procedure to be lightly undertaken; it is not a procedure for a case that may be attacked by easier means. Dacryocystorhinostomy should not be considered except where other means have been carefully tried and found wanting.

Fig. 1.

INDICATIONS FOR DACRYOCYSTORHINOSTOMY.

Recurrent ulcer
and keratitis

General septic absorption
(kidney, heart, bowel)



Chronic nasal suppurations
septal ulcers
ozoena



Pharyngitis lateralis

Recurrent tonsillitis

a. The need for speedy radical cure.

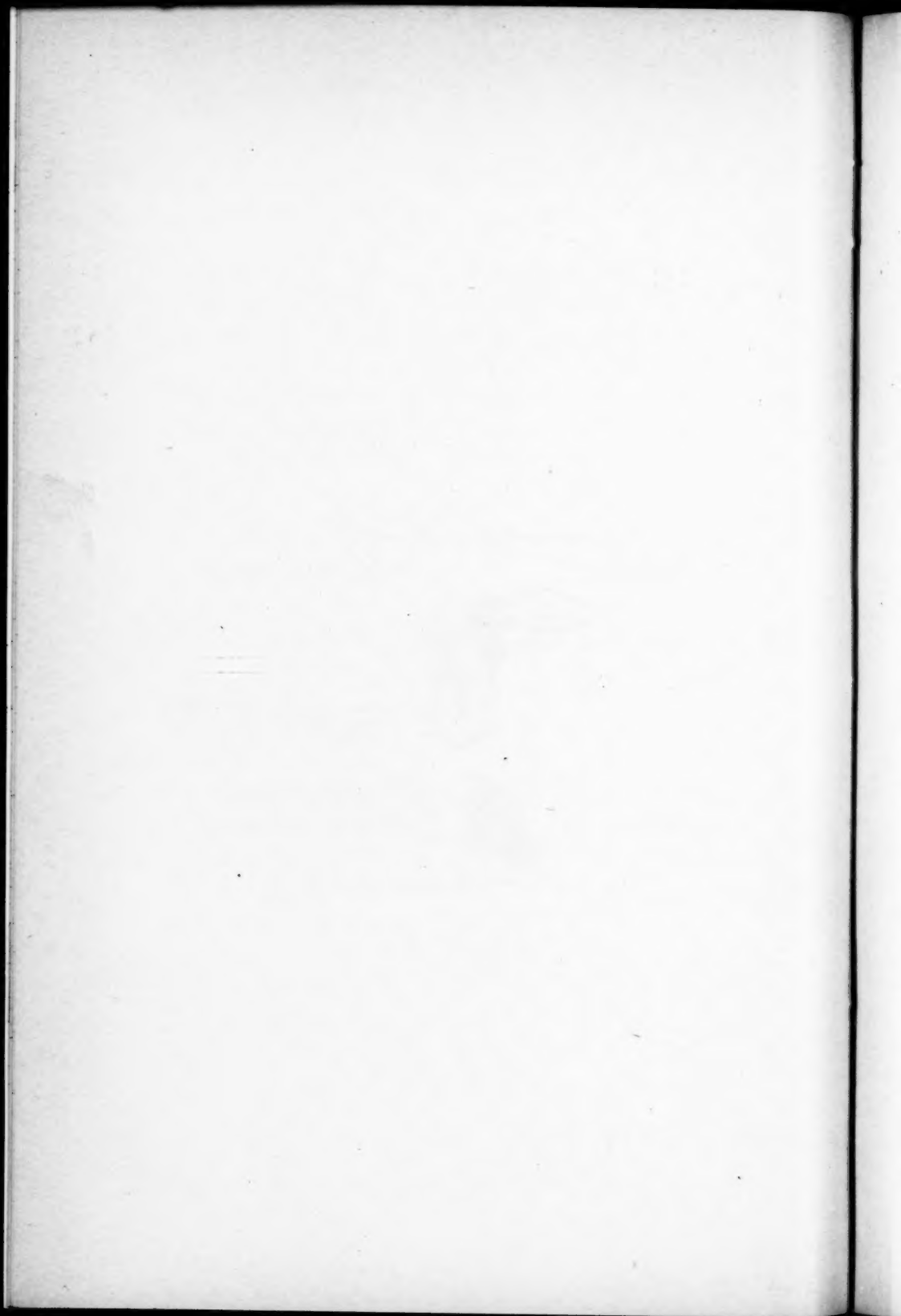
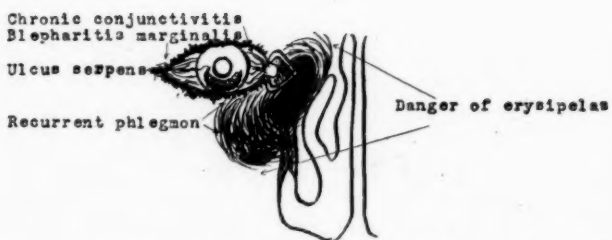


Fig. 2.



b. The need for a clean eye. (Impossibility of intraocular operations.)

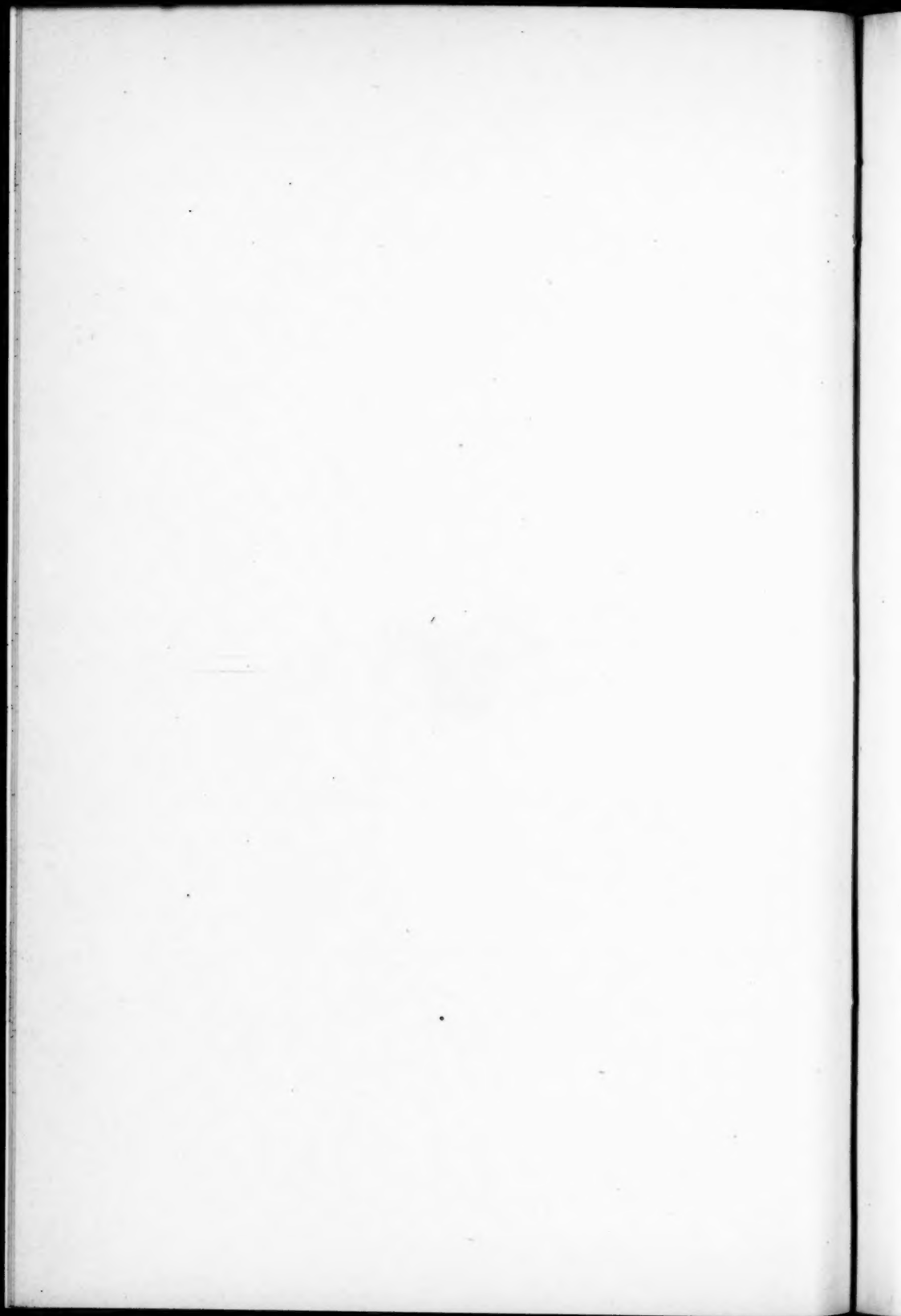
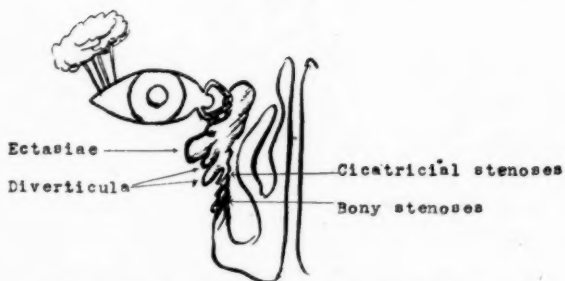


Fig. 3.



c. The need for restoration of physiologic function.

Avoidance of excision of the lacrimal gland.

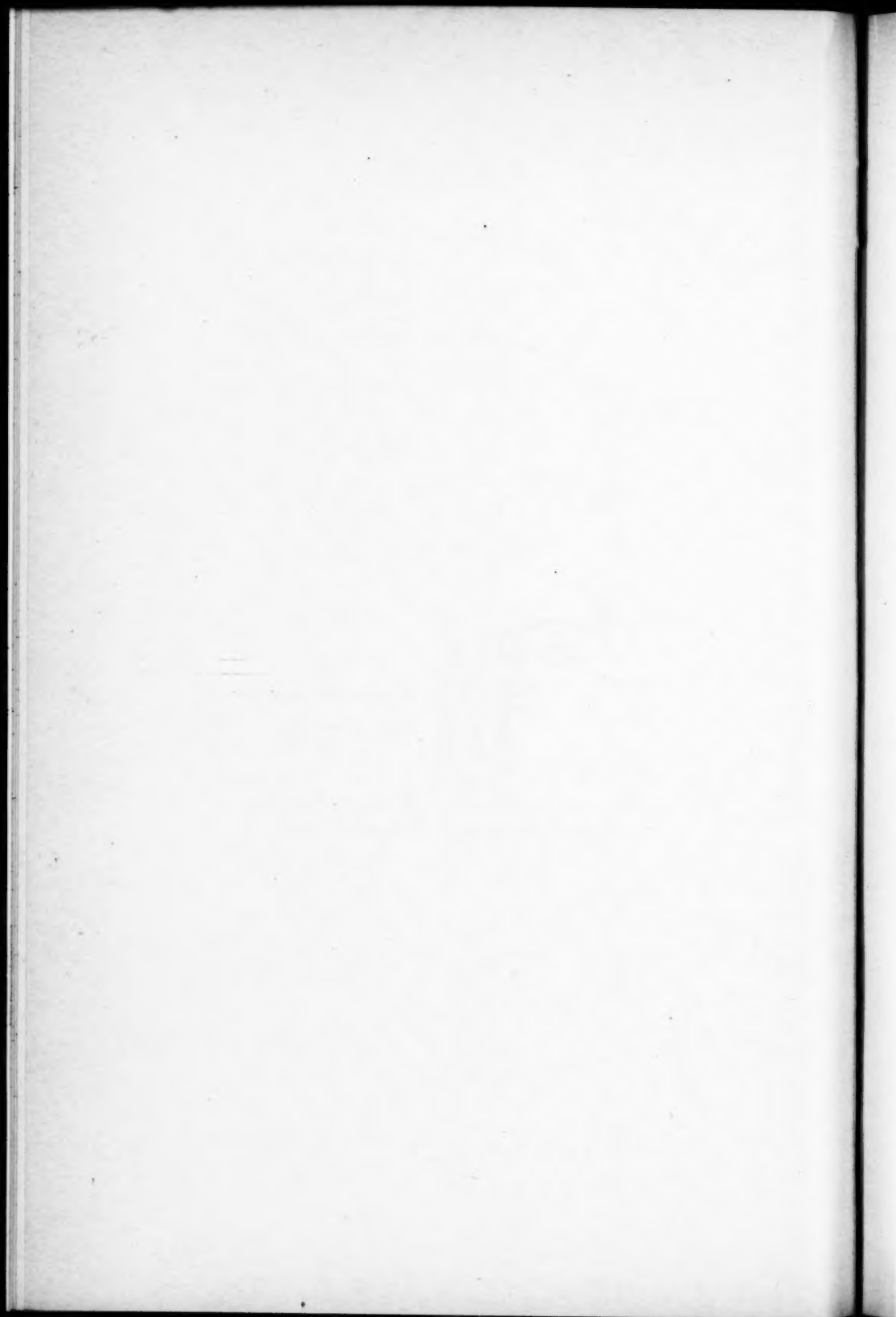
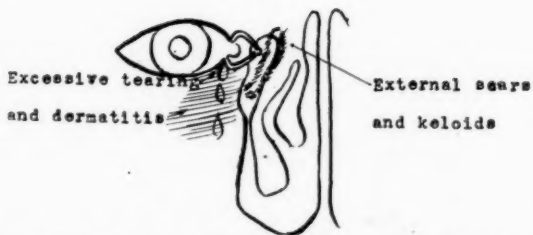


Fig. 4.



d. The need for good cosmetic results. Avoidance of dacryocystorhinostomy in all its types requires:

1. Nose must be roomy or be made so.
2. There must be one functioning canaliculus.
3. There must be enough of the sac to act as a drainage channel or syphon.

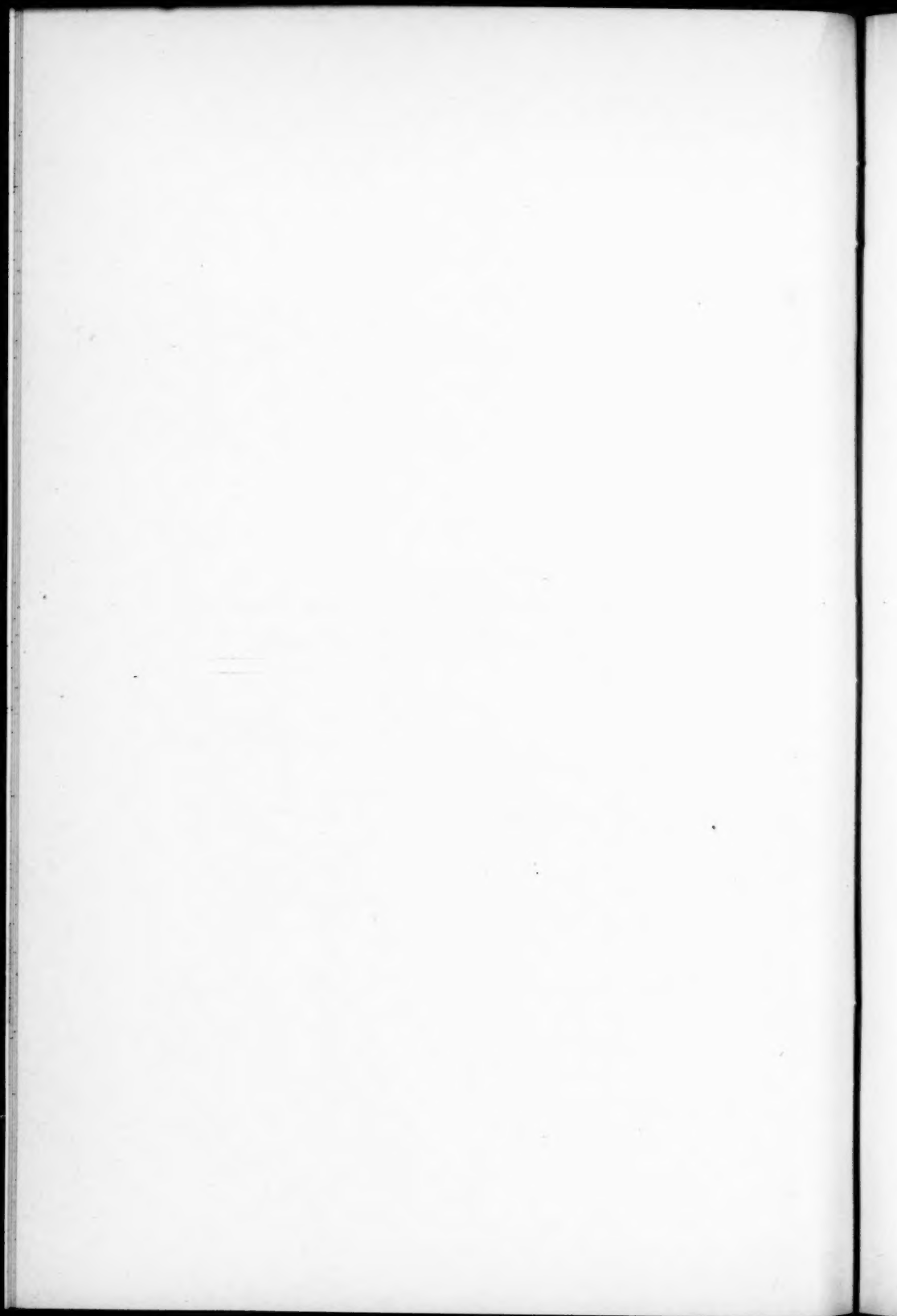
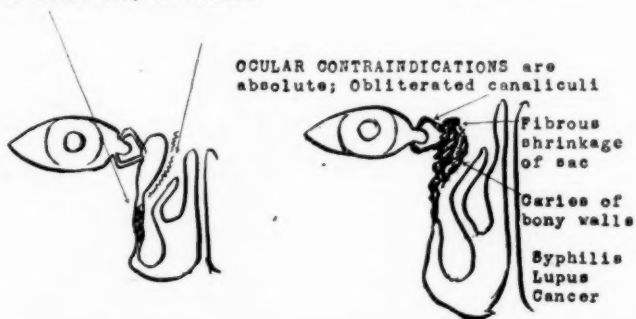


Fig. 5.

GENERAL CONTRAINDICATIONS.—In babyhood, time will take out the occluding débris. In age, palliation is preferable; beware of brittle bony structures.



Disease contraindicating general anesthesia; cardiovascular, renal; diabetes; tuberculosis and syphilis.

Keloidal tendencies in negroes; pyodermic or erysipelatous tendencies in others.

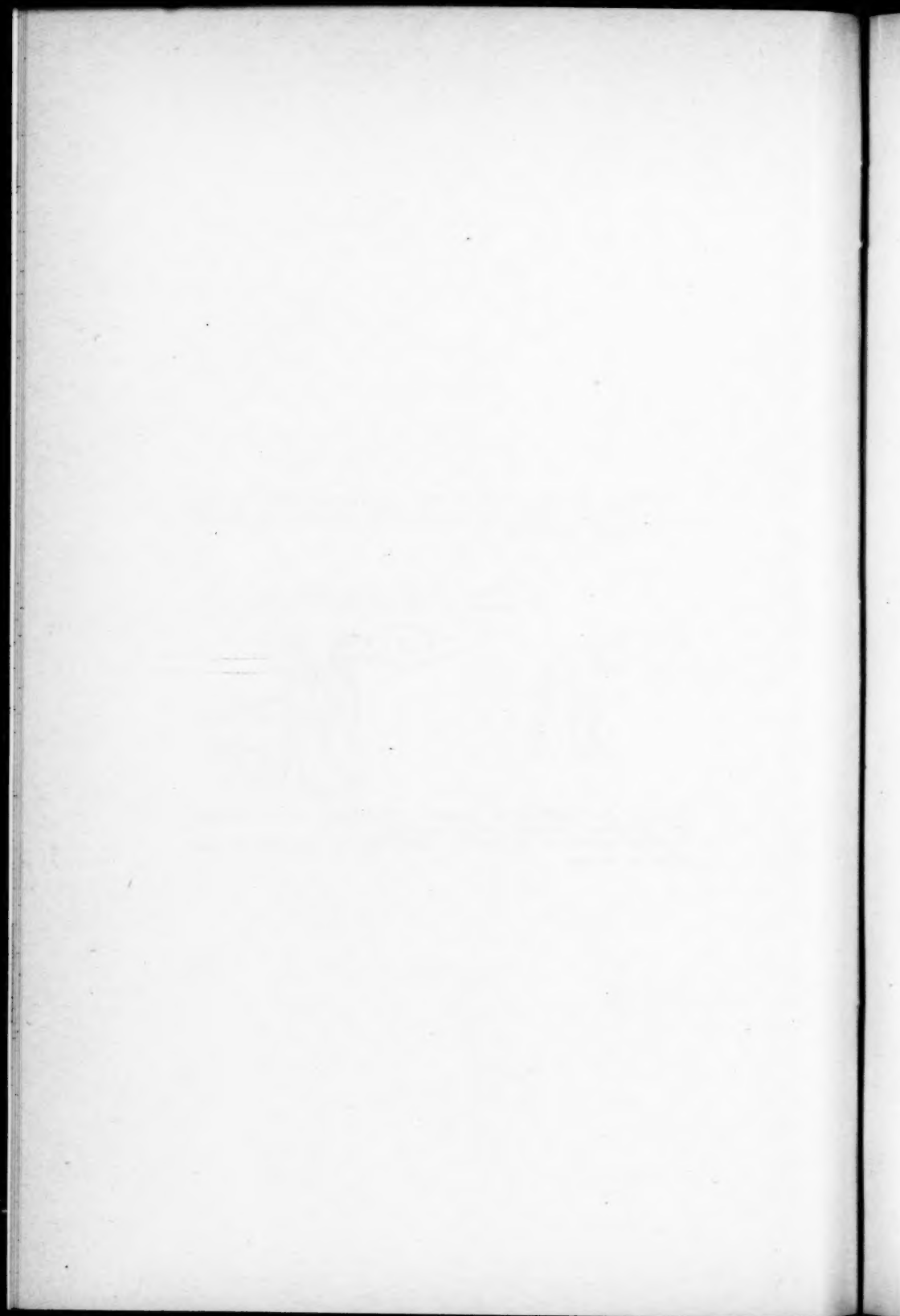
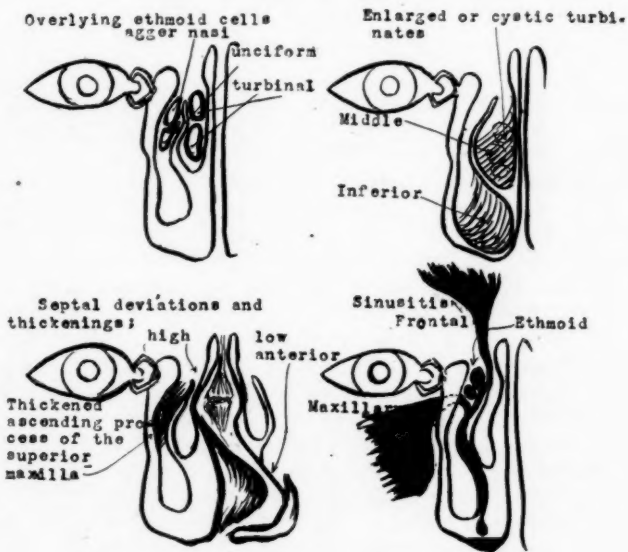
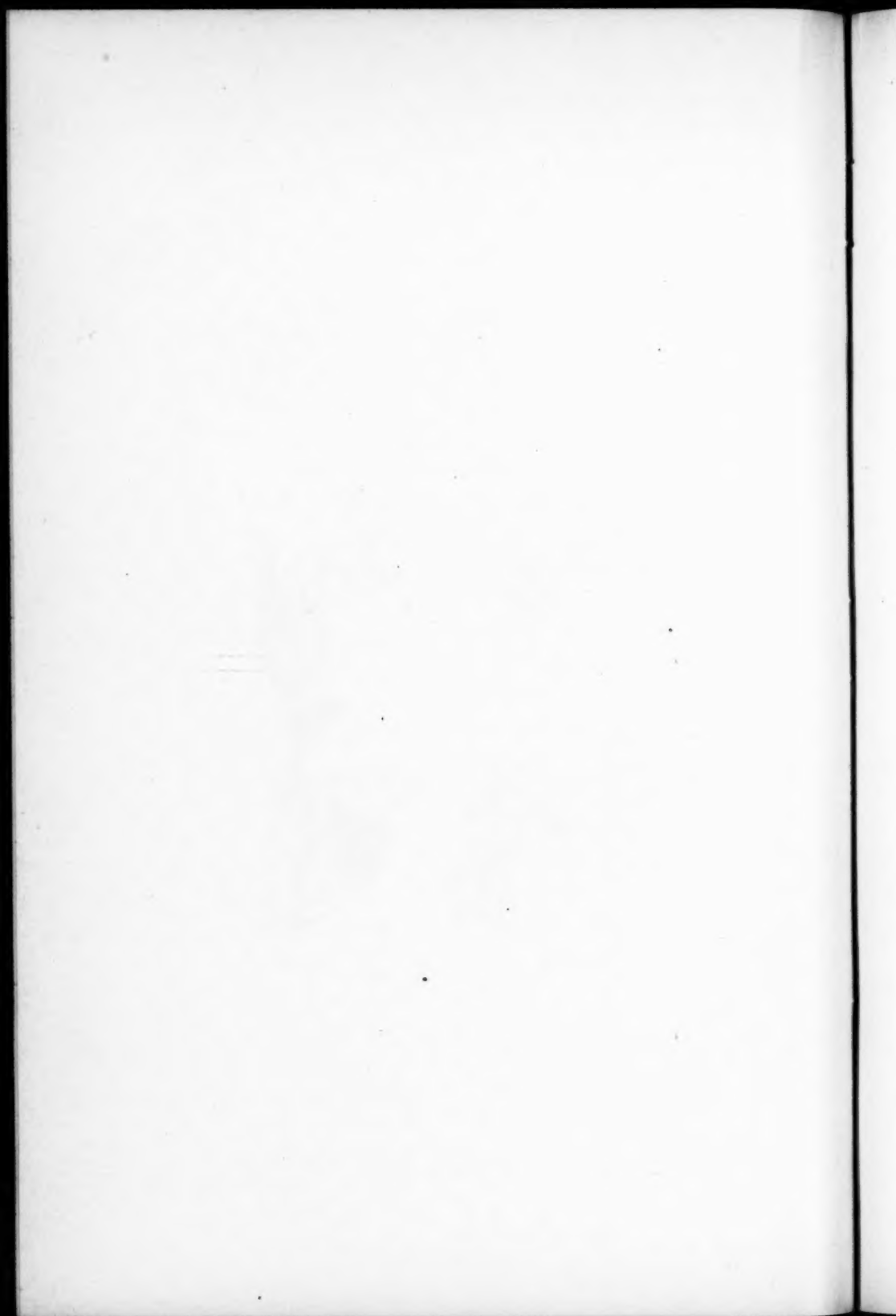


Fig. 6.

Nasal contraindications, usually remediable:





VI.

USE OF TUNING FORK STEM FOR BOTH AIR AND BONE CONDUCTION IN THE RINNE TEST.*

BY ROBERT SONNENSCHN, M. D., AND

JOHN P. MINTON, PH. D.,†

CHICAGO.

Since the method of testing the relation of bone to air conduction as first described by Rinne in 1855 is familiar to all, we will not dwell upon the details thereof. When no longer heard via bone the small a^1 fork (435 d. v.) is, according to Bezold, heard via air an average of 30 seconds longer. He found that when the fork is held only at the meatus without having been previously placed on the mastoid, the duration of air conduction is longer than when the usual Rinne test is performed, i. e., the small a^1 fork (435 d. v.) was heard 70 to 80 seconds.

In another paper Bezold calls attention to the fact that when the Rinne test is carried out in the usual manner and the fork is no longer heard with the prongs held near the meatus, if the stem be then inserted into the auditory canal, the fork is again heard via air (?) and usually for a period of about 12 seconds. Since pressure of the stem against the meatal walls tends to diminish the duration of the fork's vibration, even this test does not show the full extent to which a fork may sound. Bezold claims that "we could really determine the length of hearing by air conduction only if we were able to approach the drum membrane as closely with the prongs as we do with the stem of the fork."

*Read at May 8, 1922, meeting of the Chicago Laryngological and Otological Society.

†The work of Dr. Minton has been done under the auspices of the National Research Council as a National Research Fellow in Physics at the Ryerson Physical Laboratory of the University of Chicago.

In a short paper entitled "A Suggestion Regarding the Rinne Test" read before this society February 16, 1915, one of us (Sonnenschein) analyzed the results found in one hundred ears in which the stem of the fork was placed in the meatus auditorius externus after the bone and air conduction had been determined in the usual manner.

It was found that the fork was then heard via meatus an average of 13 seconds longer than with the prongs held near the ear. In the pathologic cases (fifty ears) the average was 10.7 seconds; in the normal cases (fifty ears) the average was 15.2 seconds. Our concluding query was that, while the fact of this prolonged hearing of the fork may prove to be more academic than practical in value, should we not apply a routine which requires but a trifling amount of extra time and may in the end bring forth enlightening data?

We have always felt, however, that placing the fork stem in the meatus did not give hearing only via air, since the contact with the tissues permitted some transmission via cartilage and bone.

In a paper entitled "A Study of the Rinne Test in One Hundred Cases" (accepted as thesis by the American Rhinological, Laryngological and Otological Society, 1921) one of us (Sonnenschein) calls attention to the fact that Boenninghaus quotes Zimmermann and Quix, who deny all value to the Rinne test because it measures the difference between two factors, namely, the vibration of the fork stem and its prongs, which are physically so different that they are not comparable. Others have also raised the same objections to this test. Boenninghaus admits this, but says that since we make the same error in each test, the results can be compared with one another, and that suffices for the practitioner, even if it does not for the physicist.

Conceding the viewpoint of Boenninghaus, which is supported by the practical experience of innumerable otologists, that the Rinne test as usually performed gives us a ratio between bone and air conduction which furnishes us with most valuable information, it seemed to us desirable to demonstrate, if possible, that air conduction was feasible by means of the fork stem. In that case the stem would be employed for both

bone and air conduction factors of the Rinne and the theoretical objections of Zimmermann and others overcome.

While the prongs move in transverse vibrations of large amplitude, the stem at the same time and for just as long a period shows longitudinal vibrations of smaller amplitude. It is desirable from the acoustic viewpoint to test both air and bone conduction by the same type of vibrations such as those given off by the stem of the fork. The present method of testing air conduction by forks is subject to a serious objection because of the disturbance of the intensity of the sound surrounding the prongs of the fork. The prongs, as is well known, move in opposite directions, so that when a condensation and a rarefaction are propagated outward these very nearly but not exactly overlap, with a resulting interference with the sound. There are distinct surfaces of maxima and minima of sound, as illustrated in the accompanying sketch. The plane surfaces (1 and 2) represent the maxima, while the curved surfaces (3 and 4) represent the minima of sound intensity. Thus the intensity of the sound changes greatly with slight rotation of the fork about the vertical axis in the figure. Not only does the intensity change about the vertical axis, but it also changes in a modified manner at various distances from the stem. In addition to these factors, there is another one of great importance, namely, the slippage of air molecules around the prongs of the forks, which varies with the amplitude and velocity of motion of the prongs and causes a further modification of the sound intensity about the fork. Moreover, all of these factors vary with the pitch, so that it is evident that air tests made in the usual manner are subject to much variation in precision. There can be no such variation as this of the sound intensity in the air surrounding the stem of the fork, and for this reason tests of air conduction made with the stem in the manner reported herein are not subject to these objections.

Anticipating what is to follow, it may be noted that there is little loss of sound energy through the walls of the rubber tubing into which the stem of the fork is inserted. Nearly all of the sound is transmitted along the air column, and little if any at all is propagated by molecular conduction along the wall of the tube.

The question of the length of the tubing is therefore not of great physical importance, and its decision may be left to each individual otologist, with the proviso that not too wide a tube be used, lest it act as a resonator (a diameter of from 0.5 to 0.8 cm. is recommended).

Although a search of the literature was made, no reference to the modification of the test as done in the manner to be described was found.

(Note.—Since the reading of this paper an abstract of an article by Stefanini of Turin was found, in which he calls attention to another method of testing both bone and air conduction by means of the fork stem.)

"The handle of the fork is attached to a disc of wood, to the bottom of which are affixed two pieces of metal of equal length and 4 mm. in diameter. To one of these is attached a rubber tube 1.4 meters long. The other metal strip is placed on the skull, and its vibrations are transmitted through bone, while the rubber tube is introduced into the ear, and the vibrations from that strip of metal are transmitted through the air, the vibrations in both cases having the same source." Stefanini also believes if the tragus is pushed into or across the meatus and the fork stem placed thereon that the sound is conducted by air. Gradenigo thinks this holds true only in normal, not in pathologic ears.

The method employed is to excite the fork in the manner chosen by each individual otologist endeavoring to do this in a definite way in order to get uniform results. We used the small *a*¹ fork (435 d. v.) of Bezold. Holding this at right angles to the body, a small pleximeter (such as employed by neurologists for testing reflexes) is allowed to drop of its own weight from a perpendicular to a horizontal position, striking the flat surface of the prong. The stem is then held against the mastoid process in the usual manner and the duration of hearing by bone conduction noted. The fork is then inserted into one end of a rubber tube, the other end of which is attached to a vulcanized rubber olive shaped tip (such as often is used with a Politzer bag) and the latter inserted into the meatus auditorius externus, care being taken that the lumen of the tip is not occluded by contact with a part of the

concha or wall of the meatus. The duration of hearing via air conduction is then noted.

The dimensions of the tubing used were: Length, 51 cm.; width of lumen, 0.7 cm., and thickness of wall, 1.5 mm. Clinically this method of doing the Rinne test was carried out on 35 cases. First the test was performed in the usual manner and then repeated by means of the rubber tubing as described.

N. B.—The sign + before the Rinne result means that it is positive—that is, air conduction longer than bone conduction. The sign — means that the Rinne is negative, namely, bone conduction is longer than air conduction.

Age, History, Diagnosis, etc.	Membrana tympani	Whisper	Weber	Schwabach	Rhino	Modified Rhine
Case 1—Age 6, F. Otitis Media. Sinistra acuta.	Right normal. Left infected and desquamating.	Rt. 5 m. + Lt. 0.5 m.	Left	Length	Rt. bc 32 ac 30 Lt. bc 44	ac 25 ac 20
Case 2—Age 48, F. Chronic tubal catarrh with some nerve degeneration, dextra.	Dullness and retraction, especially right.	Rt. 3 m. Lt. 5 m. +	Right	Length	Rt. bc 25 ac 25 Lt. bc 25 ac 30	ac 28 ac 38
Case 3—Age 27, M. Auditory nerve degeneration, sinistra.	Slight dullness; otherwise negative.	Rt. 4 m. + Lt. 0.6 m.	Right	Much shortened	Rt. bc 18 ac 30 Lt. bc 10 ac 20	ac 40 ac 40
Case 4—Age 27, M. Cerumen and very early auditory nerve degeneration.	Dullness.	Rt. 5 m. + Lt. 5 m. +	Left	Shortened	Rt. bc 18 ac 30 Lt. bc 30 ac 30	ac 40 ac 40
Case 5—Age 25, M. Otitis media suppurativa dextra chronica.	Left drum dull. Right membrane almost gone. Pus.	Rt. 20 cm.-1 m. Lt. 7 m.-2 m.	Left	Increased	Rt. bc 22 ac 15 Lt. bc 15 ac 15	ac 20 ac 18
Case 6—Age 69, M. Some nerve degeneration with middle ear.	Much retraction both sides with dullness of right.	Rt. 0.3 m. Lt. 3 m.	Right	Shortened	Rt. bc 25 ac 18 Lt. bc 20 ac 15	ac 15 ac 20
Case 7—Age 52, M. Tubal catarrh dextra with slight nerve change.	Slight dullness both drums.	Rt. 5 m. + Lt. 5 m. +	0	Shortened	Rt. bc 29 ac 25 Lt. bc 15 ac 35	ac 35 ac 40
Case 8—Age 22, F. Chronic tubal catarrh.	Slight brown discoloration.	Rt. 4.5 m. Lt. 3 m.	0	Lengthened	Rt. bc 28 ac 25 Lt. bc 25 ac 25	ac 24 ac 25
Case 9—Age 27, F. Tubal catarrh.	Some dullness.	Rt. 5 m. + Lt. 5 m. +	Left	Normal	Rt. bc 18 ac 28 Lt. bc 15 ac 20	ac 32 ac 30

Age, History, Diagnosis, etc.	Membrana tympani	Whisper	Weber	Schwabach	Rinne	Modified Rinne
Case 10—Age 55, F. Tubal catarrh with some nerve degeneration.	Slight retraction left.	Rt. 1.5 m. Lt. 3 m. +	Left	Shortened	Rt. he 20 ac 25 Lt. he 11 ac 30	ac 32 ac 30
Case 11—Age 16, M. Beginning otosclerosis (?).	Slight brownish discoloration.	Rt. 4.8 4 m. + Lt. 4.8 2.5	Right	Lengthened	Rt. he 30 ac 32 Lt. he 20 ac 25	ac 25 ac 25
Case 12—Age 38, F. Slight tubal catarrh.	Drums dull.	Rt. 5 m. Lt. 5 m.	0	Normal	Rt. he 20 ac 35 Lt. he 20 ac 35	ac 50 ac 50
Case 13—Age 46, F. Auditory nerve degeneration right.	Fairly negative.	Rt. 0.3 m. Lt. 4 m.	0	Decreased	Rt. he 20 ac 10 Lt. he 15 ac 28	ac 10 ac 28
Case 14—Age 48, M. Nerve degeneration with tubal catarrh right.	Some retraction and dullness, especially right.	Rt. 20 cm. Lt. 5 m.	Right	Increased	Rt. he 20 ac 25 Lt. he 35 ac 35	ac 15 ac 32
Case 15—Age 64, F. Beginning nerve degeneration with some tubal catarrh.	Dullness and some cloudiness.	Rt. 2 m. + Lt. 3 m. +	0	Diminished	Rt. he 16 ac 20 Lt. he 12 ac 35	ac 25 ac 35
Case 16—Age 46, M. Beginning nerve degeneration.	Right drum dull.	Rt. 6.7 2.0 m. Lt. 5 m.	0	Diminished	Rt. he 18 ac 20 Lt. he 16 ac 25	ac 25 ac 18
Case 17—Age 22, F. Otosclerosis (?).	Drums dull.	Rt. 1.3 m. Lt. 0.3 m.	Right	Lengthened	Rt. he 30 ac 25 Lt. he 40 ac 20	ac 25 ac 18
Case 18—Age 61, F. (Otitis media chronica (sln.). Nerve degeneration and chronic tubal catarrh.	Large dry central perforation, right drum dull and atrophied. Left somewhat dull and atrophied.	Rt. 0.3 m. Lt. somewhat 1 ft. 30 cm.	0	Shortened	Rt. he 25 ac 22 Lt. he 25 ac 25	ac 35 ac 25

Age, History, Diagnosis, etc.	Membrana tympani	Whisper	Weber	Schwabach	Rinne	Modified Rinne
Case 19—Age 49, F. Auditory nerve degeneration right.	Some dullness.	Rt. 10 cm. Lt. 5 m. +	Left	Shortened	Rt. bc 8 ac 15 Lt. bc 15 ac 30	ac 35
Case 20—Age 22, F. Otitis media chronica (dextra). Otitis externa (dextra).	Right drum infected. Small perforation antero-inferior quadrant. Left drum negative.	Rt. 5 m. + Lt. 5 m. +	Right	Normal	Rt. bc 18 ac 25 Lt. bc 17 ac 25	ac 28 ac 35
Case 21—Age 26, F. Otitis media chronica.	Left drum retracted. Perforation antero-inf. quadrant right drum.	Rt. 3.5 m. Lt. 5 m. +	0	Shortened (?)	Rt. bc 20 (?) ac 30 Lt. bc 25 ac 24	ac 30 ac 24
Case 22—Age 33, M. Tubal catarrh chronic.	Retracted and dull drum membranes.	Rt. 1.5 m. Lt. 5 m. +	Right	Shortened (?)	Rt. bc 27 ac 25 Lt. bc 28 ac 35	ac 31 ac 38
Case 23—Age 40, M. Tubal catarrh and some nerve degeneration.	Drum membranes fully negative.	Rt. 1.5 m. Lt. 2 m.	0	Shortened	Rt. bc 15 ac 20 Lt. bc 15 ac 15	ac 20 ac 20
Case 24—Age 48, M. Chronic otitis media with nerve degeneration.	Right scar near center. Left dull.	Rt. 20 cm. Lt. 1 m.	Right	Shortened	Rt. bc 12 ac 0 Lt. bc 15 ac 0	ac 0 ac 0
Case 25—Age 61, F. Otitis media chronica (sin.). Nerve degeneration with chronic tubal catarrh right.	Large dry central perf. oration left, with retraction right drum and atrophic.	Rt. 0.3 m. Lt. 20 cm.	0	Shortened	Rt. bc 25 ac 30 Lt. bc 25 ac 22	ac 35 ac 25
Case 26—Age 52, F. Tubal catarrh.	Dullness both membranes.	Rt. 4 m. + Lt. 4 m. +	Right	Increased	Rt. bc 24 ac 25 Lt. bc 20 ac 38	ac 33 ac 42*
Case 27—Age 41, F. Normal ears.	Negative.	Rt. 5 m. + Lt. 5 m. +	0	Normal	Rt. bc 24 ac 35 Lt. bc 22 ac 35	ac 40 ac 40

Age, History, Diagnosis, etc.	Membrana tympani	Whisper	Weber	Schwabach	Rinne	Modified Rinne
Case 28—Age 48, F. Normal.	Negative.	Rt. 5 m. + Lt. 5 m. +	0	Normal	Rt. bc 29 ac 40 Lt. bc 22 ac 43	ac 40
Case 29—Age 23, F. Normal.	Negative.	Rt. 5 m. + Lt. 5 m. +	0	Normal	Rt. bc 25 ac 45 Lt. bc 25 ac 45	ac 45
Case 30—Age 20, M. Normal.	Negative.	Rt. 5 m. + Lt. 5 m. +	0	Normal	Rt. bc 25 ac 45 Lt. bc 25 ac 45	ac 45
Case 31—Age 30, M. Normal.	Negative.	Rt. 5 m. + Lt. 5 m. +	0	Normal	Rt. bc 18 ac 50 Lt. bc 20 ac 40	ac 50
Case 32—Age 60, F. Otitis media chronica sinistra.	Retraction right mem- brane. Much de- struction left membrane.	Rt. 3 m. + Lt. 1.5 m.	0	Increased	Rt. bc 25 ac 28 Lt. bc 24 ac 22	ac 26
Case 33—Age 54, F. Otitis media acuta (dextra), healed.	Drum membrane neg- ative except slight injection of right.	Rt. 2.5 m. Lt. 5 m. +	Right	Normal	Rt. bc 20 ac 18 Lt. bc 20 ac 35	ac 20
Case 34—Age 25, F. Otitis media acuta (sinistra).	Left drum red. Small perfora- tion.	Rt. 5 m. + Lt. 0.6 m.	Left	Normal	Rt. bc 35 ac 40 Lt. bc 30 ac 25	ac 45
Case 35—Age 18, F. Normal ears.	Negative.	Rt. 5 m. + Lt. 5 m. +	0	Normal	Rt. bc 22 ac 30 Lt. bc 22 ac 35	ac 40

N. B.—In the above table Weber designated as zero means no lateralization. Right or left refers to the side on which fork is best heard. Since examining room was only about 5 m. long, the hearing is usually designated as plus where 5 m. is noted, since the hearing was greater than the distance at which tests could be made.

Of these cases, 6 had normal ears, 12 showed either tubal catarrh or acute or chronic otitis media, one was apparently a typical otosclerosis, one was suspicious of a beginning otosclerosis, 5 showed auditory nerve degeneration and 10 apparently had both middle and internal ear changes.

ANALYSIS OF CASES.

We see that in 23 cases the air conduction in both ears was from 3 to 15 seconds longer when the fork was connected with the tube. This group included 4 normal ears, 5 cases of nerve degeneration, 8 combined middle and internal ear cases, and 6 cases of pure middle ear affection. In 2 cases (one normal, the other a chronic otitis media with some nerve change), the hearing in both ears via tube was the same as when the prongs were held near the ear in the usual manner. In 5 cases, only one ear showed the same length of hearing by both methods. The fork was heard a shorter time with tubing than with the prongs of the fork by from 2 to 10 seconds in 9 cases, of which 2 were moderate nerve degenerations, one a combined middle and internal ear involvement, 4 showed either tubal catarrh, acute or chronic otitis media, and 2 were the otosclerosis cases before mentioned.

The fact that some cases with very distinct middle ear affection and a negative Rinne showed less hearing of the fork via tubing and tip in ear than when the prongs were held near ears seems to show that in the method we have used the hearing of the stem is by air and not by bone conduction; otherwise in these very cases it ought to be increased just as it is when the stem is held against the mastoid process. Objections might be raised to this method of testing air conduction, such as the fact that it is the wall of the tube or hard rubber tip which transmits the sound waves to the cartilage or bone of the meatus and surrounding parts just as when the rounded end of the fork stem is inserted directly into the meatus.

It can, however, be demonstrated that sound waves are transmitted almost entirely through the confined column of air within the tube and not by the walls thereof. Molecular vibrations, however, may be conducted by the tube wall, but the following experiments will show that no such vibrations are present in these tests and that what is heard is entirely by

air conduction. When tubing is clamped in a vise (a length of about 10 cm. being compressed) the sound of the fork is not heard via tube lumen. If the fork is placed on the outside of the tube the sound is heard if the fork rests between the vise and the ear, but if it is put on the farther side of the tubing—i. e., beyond the vise—nothing is heard via tubing. If the rubber tube is cut and the sections held in proximity but not in contact with one another the sound of the fork is heard via tube lumen; but when section is clamped in the vise there is no transmission of sound. When a steel tube is placed in the vise and the fork rests on it, the sound is transmitted, since the lumen, of course, is not compressed. If a steel rod 8 or 10 cm. long is inserted into the ends of the tube sections the sound of the fork is not heard via lumen of the tube. Plugging the opening in the olive hard rubber ear tip with wax, wood, etc., merely reduces the intensity of the sound heard. That a little of the sound is transmitted through but not along the tube wall to the outside is shown by the fact that when the tubing or olive tip are held tightly against the auricle a faint sound only is heard. When thus held, however, and with the olive tip open, the sound is heard, thus showing that the sound is transmitted to the ear through the open end and only slightly through the wall of the hard rubber olive tip.

From the clinical standpoint we believe that the results obtained in a number of cases show definitely that the fork when used with tubing and tip in the ear is not heard via bone but only via air.

In several cases, presumably with otosclerosis or some other middle ear involvement, where a prolongation of bone conduction, either relative or absolute, would be expected, we find, as previously noted, that with the tip in the ear the fork is heard a shorter time (i. e., fork on mastoid) than were the prongs heard via air.

Permit it to be said that in presenting the results of this little investigation there has been no intention of discrediting in any degree whatever the Rinne test, which gives the otologist such valuable information, but merely to show that the stem of the fork may be used for determining the duration of both the bone and air conduction.

CONCLUSIONS.

1. Physical experiments show that with the fork stem inserted in the end of a rubber tube the sound waves are transmitted to ear by air column and not by way of the tubing wall.

2. Clinical findings show that with fork stem in tubing connected with the ear via hard rubber olive tip, the sound is in many cases heard somewhat longer than with prongs held near the ear. In most cases, however, of middle ear disease, especially those with negative Rinne, the hearing via tube was somewhat less than that with the prongs, whereas if the hearing had been via bone conduction it should have been increased with the tip in the ear.

3. It therefore seems feasible to determine not only bone conduction as is usually done, but also the air conduction in the Rinne test by means of the stem of the fork.

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29 E. MADISON ST.

VII.

AURAL EXOSTOSIS.*

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Although aural exostoses are known to have been fairly common centuries ago, history fails to record any effort to obtain comprehensive knowledge of the affection until as recently as 1877, when J. P. Cassells in the *British Medical Journal* claimed "to be the first observer who has given a rational explanation of aural exostosis, supported by clinical and pathologic facts." While in recent years some advancement in scientific knowledge of this disease has been made, and while many views have been given as to the cause of the condition, its etiology is still largely speculative. On review of the literature one finds that the only etiologic factors upon which the majority seem to agree are that of the influence of heredity and that of some forms of local chronic irritation, noninflammatory or inflammatory. As in otosclerosis, while the anatomic changes of the disease are quite well known, the pathogenesis is still in the realm of uncertainty. Therefore one ventures to think that the imagination may be given full play. It is interesting to note that the hypotheses advanced as to the etiology of otosclerosis are practically identical with those suggested in exostosis of the aural canal. According to Gray, exostoses are not infrequently found in the bony labyrinth. He has reported cases of otosclerosis which at autopsy showed exostoses in the region of the promontory, oval and round windows. He quotes Katz as having recorded a case in which the hammer and the anvil suffered. Fischer found exostoses on the stapes in this connection also. The writer ventures to think that aurists making a comparative study of the two conditions will be, as he is, impressed with the belief that the two processes differ fundamentally in the point of

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location only. Later on in the paper this statement will seem less radical. There is abundant evidence that this disease was once very frequent among primitive races. In reviewing the literature and contrasting reports of prehistoric specimens with those of modern times, one can but be convinced that in the dim and misty past there were etiologic factors which exist now in part only. To review the literature, present a case, report a comparatively large number of unreported exostoses in prehistoric specimens and to postulate what seems to the writer a logical theory as to the fundamental cause of the condition, is the purpose of this paper.

In going through the literature of this subject, one is greatly confused by the lack of uniformity or system in the terminology. Each author has a different nomenclature or none at all. Should not "canal" be used instead of "meatus"? Would it not be better for "exostosis" to take the place of "hyperostosis" and "osteoma" until a definite pathologic basis for a classification is agreed upon by all? By Kerrison, Blake and Field, all bony growths of the canal are considered "exostoses," while Politzer, Peters, Ellis, Moss, Connal, Davis, Lake, Green and Hartman use the more complicated terminology. Ballenger says that hyperostoses and exostoses are often spoken of synonymously, although according to strict pathologic interpretation they should be used to describe different lesions of bony tissue, the former being the diffuse thickening of the wall. Pritchard and Blake regard the hyperostoses as resulting more particularly from chronic inflammation, while Field speaks of the general thickening of the wall as the rarest form of exostosis. Sheppard reports two cases of "osteoma" and Ballance one "of the temporal bone blocking the outer part of the external meatus."

As in terminology, so in the matter of etiology there is great diversity of opinion, in some instances views of equally qualified otologists being diametrically opposed. All references credit these growths with being single, multiple, unilateral or bilateral, and in form broad based, flat or pedunculated, some even without a bony attachment (Schumacher, Jacquemant and Delstanche). In frequency, Blake places them at five per thousand, Sheppard at four to five, and Jackson at eleven per three thousand cases of aural disease, showing a compar-

ative rarity today. Green believes they occur in fetal development, youth or early adult life. Dalby said they were congenital. Kerrison quotes Bezold, believing that the condition is rarely or never developed before puberty, but in contrast Hartman states that their growth terminates with the growth of the individual. As to the point of origin and location, Cassells believed that they always arise from the mastoid periosteum of the outer half of the canal and always from the posterior wall; Pritchard and Blake, on the bony walls or the outer edge of the osseous meatus; Cassells and Pritchard again, and Ballenger, at the junction of the osseous and the cartilaginous canals. Kerrison, Blake, Jackson and Green have found them most often on the anterior or posterior walls—if single, on the anterior near the drum. Politzer alone mentions their existence on the floor or inferior meatal wall, and Ballance has published the only reference to one on the roof or superior wall—i. e., Toynbee's case, and yet Cheattle limits them to the tympanic portion of the temporal bone. In point of location in the canal, Green places hyperostoses farther out than exostoses, and reports a case of exostosis in which the osseous canal was missing, except the upper and lower posterior portions, the growth being attached to the tympanum or attic. He also reported two other cases of bony growth located just within the meatus originating from the cartilaginous portion of the canal, and Lichtenberg one also.

Cassells believed that these growths are due to a rupture of a subperiosteal abscess into the canal at the junction of the cartilaginous and bony portions, or through the cartilage, discharging pus, and that the exostosis resulted from ossification of the granular growths that spring up from the abscess opening. St. John Rossa in 1866 published four cases of "true exostosis," "morbid growths consequent on local irritation," in three being pus from the middle ear. Cocks reported a case showing bony metamorphosis in two polypi, in the course of an O. M. P. C. Pritchard held that one type of multiple exostosis originates in this manner, but Weydner reported thirteen aural polypi examined microscopically and says that he has never been able to discover new bone formation in any that he has examined. Knapp definitely states that the pathogenesis is this—O. M. P. C., periostitis, polypi, and finally

exostosis, using a case of 34 years' otorrhea as an illustration. Ballenger, Politzer and Jackson believe the condition may be due to a fracture of the bony canal and the resulting periostitis or a chronic middle ear suppuration might excite a secondary inflammation of the membranous canal, causing a fibrous or connective tissue thickening which after a long period of time might be metamorphosed into osseous tissue. Green believed them to be the result of a circumscribed periostitis and found only in adults rather than youths. Carmalt regarded only the fibrous covered exostoses as inflammatory in origin, the cartilaginous being otherwise. McBride has reported a case of exostosis filling the canal, with a history of repeated attacks of inflammation, and Dalby two associated with O. M. P. C. Lucae's patient had otorrhea for 23 years and the canal was practically occluded by two bony growths. One patient of Toynbee's suffered from a foul discharge for 20 years, and he stated that in 1013 diseased ears examined, 14 showed narrowing of the external meatus as a result of bony tumors from the osseous walls.

In the opinion of Field, aural exostoses are caused by some local source of irritation, in many cases this being irritation by salt water repeatedly introduced through protracted bathing. Two of his 27 cases gave sea bathing as a cause. Dalby, Pritchard and Jackson concur in this opinion, and the latter quotes Koerner, 147 cases, with those living by the sea most affected. Connal states that this condition is more prevalent in England than on the continent and extremely frequent among the South Sea Islanders. Ballance has reproduced two cases, one of a Chatham Islander, and one of a Melanesian Islander (Welcher), but states that "constant bathing in the sea is not the sole cause of these growths." Exostoses of the external meatus often occur in those born in former German Africa, as well as in the German troops stationed there—a residue of a chronic ossifying periostitis of the meatus endemic to that country (Müller). These possessions are on salt water. Blake is opposed to the aquatic theory, mentioning the fact that the mound builders, a large percentage of whom are known to have had exostoses, lived inland.

Ballenger and Pritchard believe that in some cases syphilis may be a factor, although not to a great extent. By Blake,

too, quoting Toynbee and Gruber, syphilis is given a very meager role. Jackson regarded this disease as seldom if ever the cause, and Field denies any conclusive evidence at all as to the luetic origin. Ballenger and Field state that gout is thought to be another cause, but say it is doubtful if this leads directly to their formation. Pritchard and Connal believe that rheumatism may be added to the list. In Blake's list, again referring to Toynbee and Gruber, both gout and rheumatism are found. Their syphilitic, gouty or rheumatic relation can only be held valid when other osseous tumors occur simultaneously in other parts of the body, the origin of which can be traced to the original disease (Politzer). By Kreible and Bergeim, a metabolic study of a case of multiple exostosis was made with the result that the findings did not support the view of a relationship of this disorder to rickets or "to any primary disturbance of the general metabolism."

Heredity is listed by Ballenger as an etiologic factor, saying that this condition may be traced through a few generations. Dalby saw exostoses in the aural canals of a father and two sons and regarded them as congenital in some cases. Politzer quoted Schwartze regarding a hereditary predisposition as a factor, having seen such cases several times. Hartman reports a mother and sister having the same condition, and quotes Boyer, who reported a female whose father, brother, three sisters, two nephews and all her own children also were affected. He also exhibited two specimens of hyperostosis and held them to be anomalies of development for the reason that (a) they appeared simultaneously in both ears, (b) that they were limited to the pars tympanica, (c) that there was a uniform consistency of the rest of the bone. Lake denies Hartman's theory, but Politzer regards some cases as arising during the stage of development and ossification. Green, while mentioning a case of Jacks, reports three "true osteomata" of the mastoid, which he believes were probably of slow noninflammatory growth, probably fetal in origin, originating in the tympanum or close to it. All were covered with normal skin. In two the osseous portion was overlaid with cartilage, and in one with fibrous tissue. In the discussion, Carmalt expressed his belief that the cartilage covered ones were fetal in origin and the other inflammatory. Whitney ascribed them

to fetal cartilage rests. Peters had a case in which there was prominence of the supraorbital and temporal ridges, suboccipital ridge marked, and hyperostoses of the nasal bones as well as of the lower jaw anterior to the masseters. In the discussion of this case, Jones suggested that general hyperostosis of the skull might be a stigma of degeneration. Politzer states that in many instances the cause is not ascertainable at all, because the development is not accompanied by inflammatory phenomena, and we are seldom in a position to observe their growth clinically. In view of all this confusion as to the causation we may hide behind Virchow's statement that the etiology of these growths is an irritative disturbance of normal bone development. This "irritative disturbance" may be of any kind or variety, but the underlying question of why the condition arises in some and not in others with a similar aural disturbance cannot be answered with certainty until the broad question as to the etiology of all new growths, malignant or benign, has been answered. The balance in cell growth is in some way upset by a vasotrophic element or an irritative one or by some factor which in many cases may be of such a nature that no history can be elicited. Naturally in a case that we may say is idiopathic or spontaneous in origin, the patient can give no history except perhaps one pointing to a general bodily condition which may be present.

Of historic interest in treatment are two cases refusing operation that Barr improved in respect to hearing, by providing a narrow chink through the canal by counter-irritation behind the ear, leeches on the tragus, and iodine liniment. Dental burrs, snares, metal rods and laminaria tents have been advised, the dilatation method being that of the early aural surgeons, von Trölsch and Bonnafont. Politzer recommends operation for removal of (a) marked deafness due to complete closure exits, (b) marked deafness with disturbance of hearing in the other ear, (c) inflammation in the external ear with interference with drainage, doing a radical mastoidectomy if the condition is complicated with an O. M. P. C., otherwise the gauge and mallet through the external canal. Goldstein interferes surgically for (a) pain from mechanical pressure, (b) obstruction to free drainage, (c) serious impairment of hearing. Field believes they should be removed

only if they interfere with free drainage; Connal also. Powell advises a mastoidectomy in case of middle ear suppuration, but suggests that one should not operate in cases of exostosis with a broad base because of the fear that growth might extend into the tympanum. The chance of benefiting the patient should not be rejected because of this possibility, according to West. Selfridge in a personal communication referred to a case of his own in which it was necessary to do a bilateral modified radical operation after many minor operations had been tried. Finally one ear was converted into a radical mastoid on the advice of Duel and of Hammond, owing to the formation of an exostosis in contact with the annulus.

With the view of laying a further foundation for part of my conclusions, the development of the osseous canal has been studied. According to Kerrison, firm osseous union of the annulus with the rest of the temporal bone occurs during the first year of life, the free ends of the ring having united with the squama about the time of birth (Spalteholz). By deposition of new bone upon the outer surface of the tympanic ring, the annulus is converted into a bony trough, citing the fact that the sulcus tympanicus remains unchanged at the inner margin of the canal as proof that the conversion of the tympanic ring into a partial canal is effected solely in this manner. In Quain's Anatomy one reads that the tympanic element begins in the form of an incomplete ring to which the membrana tympanica is attached. On the outer side of the ring is a fibrous plate occupying the same position in the wall of the meatus as the future bony plate. Ossification extends from the annulus into this fibrous tissue. Hertwig-Mark, in their textbook, call attention to the fact that the annulus gradually becomes broadened into a bony plate which fuses with the petrosal bone. This growth does not occur uniformly from the ring, but mainly from two tubercles situated one near the upper end of its anterior limb, and the other at the lower posterior, so that the outer edge of the tympanic bone at this stage exhibits a notch which by the subsequent union of the two tubercles is converted into a foramin. This aperture occasionally persists until adult life, and in cases where it is closed, the osseous wall remains thin. While these changes are forming an osseous wall in front, below and be-

hind, the squamous part of the temporal bone situated above the membrana tympanica grows outward and comes to be nearly at a right angle with the vertical plate of the squamosa so as to form a roof. This process of formation is usually completed during the second year. Minot simply states that "the tympanic ring is incomplete on the lower anterior side and remains so for several years after birth." To illustrate the process of fetal development, the specimens in the San Diego Museum, Anthropological Department, have been photographed and the pictures with some descriptive matter are here presented.

All reports point to the origin of these growths from the anterior and posterior walls—practically never from the floor or roof (only one or two exceptions). Disregarding the many theories as to the direct cause, may not one assume that if the exciting agent be some form of chronic irritation and the potentialities of all four walls be equal, the most dependent part, the floor, would be the wall receiving the maximum stimulation, and hence should be the area most frequently productive of these overgrowths? But since the floor is almost never involved in the process, one seems justified in assuming other etiologic factors than chronic irritation. It seems logical to believe that the exciting agent, whatever its form, acts equally upon the entire canal, but is responded to only by those points especially susceptible to the stimulus. In the vast majority of cases reported only those areas responded to this stimulation, whatever it was, which during the development of the canal grew most rapidly. These places, as has been shown by the embryologic study, are the two ends of the annulus from which the osseous canal proliferated the more rapidly into the fibrous anlage. May not these areas have retained the potentiality of more rapid development and response to any production stimulus? The answer "yes" to this question is the writer's theory as to why the vast majority of aural exostoses are found along the suture lines between the canal and the rest of the temporal bone.

Ever since examining with Dr. Politzer his unusual collection of exostoses of the aural canal, I have been looking for a case. During this period three examples of the process have

come under my personal observation. One has been of special interest to me and is as follows:

Mr. P., age 39, Scotch-Irish, married, five children.

C. C.: Impaired hearing, almost totally deaf; mild tinnitus; sometimes very dizzy; paracusis Willisii.

Family history: Father died of "bleeding piles." At age of forty had a "growth like gristle" removed from the right mastoid. Growth had been growing rapidly enough to cause annoyance. Brother died of "cancer." No history of family deafness could be gotten.

Past history: When the patient was seven months in fetal development his mother was thrown from a horse; hemorrhages of several days' duration followed and emptying of the uterus was advised. Operation refused and pregnancy continued to full term. At birth he "looked like he had no blood at all" and continued weak and anemic until about the age of five. Measles, but no ear involvement.

At the age of two he fell, striking the back of his head, and was unconscious for almost an hour and the same night had a "spasm." These continued every few days until the patient was about five. Since then he has been entirely well.

At the age of eight he began to swim in fresh water. At thirteen he moved to San Diego and since then has swam in salt water, practically "living in the water," as he says. At fourteen he began high diving, from forty to sixty feet, continuing as a professional high diver until 1920.

"Sciatica" often. No positive venereal history.

P. I.: At age of sixteen, noticed that he was having difficulty in clearing his ears of water after diving. This gradually became worse until the sensation of an unremovable obstruction with terrific buzzing in the left ear nearly "drove him wild." The buzzing in the right ear began in 1915, just before he came to the San Diego County Ear Clinic. The impairment of hearing in the left ear began about the age of 19. In his attempts to remove the accumulated water from the ears he would often cause bleeding and swelling of the external canals. The canals have always been rather insensitive, with no wax except a few dry light brown scales for the past ten or twelve years. Never any pain or earache. Hears high-

pitched voices better than the low. Canals have been lanced previously, diagnosis of "furunculosis."

Examination: Both canals closed externally by hard, insensitive, immovable growths covered by apparently normal integument. Hears only shout, and the watch on contact, both ears. A. D.: C negative, C² heard faintly, C⁴ heard, Galton O. K. A. S.: C negative, C² negative, C⁴ heard, Galton O. K. Weber to left. Rinne negative, both ears. Schwabach prolonged, both ears. Slight transitory improvement on inflation. Depletion of the canal walls so that a Yankauer eustachian applicator with a bit of cotton on it could be passed caused a marked improvement in the hearing.

At the same time the patient complained of susceptibility to head cold, alternating nasal stenosis with especial disturbance on the right, postnasal dripping, frequent hawking and a dry, irritable throat. Nasal examination showed an edematous mucosa, with a deviated septum in contact with the right middle turbinate body. Slight impairment of translucency of the right antrum.

Operation on the ears was refused, but a submucous resection was agreed upon. Resection done in the clinic in 1915, with relief of the nasal symptoms, except some slight basomotor disturbance at times.

Between this time and 1920 the patient came at intervals of a few months to have his canals treated. Finally, in August, 1920, in the hope for relief from his increasing deafness and the unbearable tinnitus, he consented to an operation.

Physical examination negative; no skeletal abnormalities noted.

X-ray: "The auditory canal on the left is narrowed to about one-third of its normal size, probably throughout its entire length, but it is not occluded. The auditory canal on the right is almost completely occluded, but this shadow is not dense and the occlusion is probably very thin. Certainly this occlusion does not extend throughout the entire canal." (Dr. L. C. Kinney.)

Operation: Operation was advised and accepted. A modified meatomastoidectomy was done on both sides August 17, 1920. Wounds healed in two weeks, leaving a fair sized canal on both sides.

Hearing greatly improved subjectively. A. D.: Voice, 23 feet (full length of room); whisper, 23 ft. ?; acoumeter, 23 ft.; C⁶⁴, plus; C⁴, plus; Rinne plus; Schwabach normal; Weber to left; Galton, full range. A. S.: Voice, 20 ft. ?; whisper, 20 ft. ?; acoumeter, 9 ft.; C⁶⁴, plus; C⁴, plus; Rinne plus; Schwabach slight increase; Galton full range.

The patient returned July 13, 1921, complaining of a return of the deafness and tinnitus in the left ear. Right ear still normal as far as he could tell. Fork tests showed a return of the left ear to about the original findings when first seen. Examination of the left canal showed the drum hidden by two deeply placed hard, insensitive, noninflammatory growths, sessile, one on the anterior inferior wall and the other on the posterior wall. A narrow slit only existed between them. The patient was willing to have another attempt made to relieve the deafness and the tinnitus. So August 10, 1921, complete meatomastoidectomy was done. A dry cavity remaining from the previous operation was opened and the entire posterior bony canal wall (i. e., what remained of it) was removed down to what was thought to be the annulus. A sessile bony growth 3x3x5 mm. was removed intact. Closure by means of Panse flaps. The small exostosis on the anterior inferior wall was not touched because of the feeling that enough had been done to relieve the symptoms. In about three weeks the entire wound was healed, the opening into the middle ear closing also. With the subsidence of all reaction the upper anterior portion of the drum was visible through a triangular opening about three mm. on each side. At this time it became apparent that the exostosis removed with the posterior wall lay external to the annulus which, as near as could be made out, had become enlarged, extending into and involving the drum. It had not extended inward so as to entirely occlude the tympanum, for medication applied to the canal could be discharged through the eustachian tube into the throat. At present the patient still complains of some tinnitus and very slight impairment of hearing, and the functional examination shows:

A. D.: Whisper 23 ft.; acoumeter 23 ft.; C⁶⁴ plus; C⁴ plus; Weber not lateralized; Schwabach normal; Galton full range. A. S.: Whisper 20 ft.; acoumeter 20 ft.; C⁶⁴ plus; C⁴ plus; Schwabach normal; Galton full range.

In the endeavor to discover the cause of this condition, especially since it seemed to be progressive, on the left side at least, an investigation of the patient's general condition was made. Stereoscopic plates of the sella showed "apparently nothing which gives definite radiographic evidence of a departure from the normal in this particular case." (W. O. Weiskotten, M. D.). The Wassermann reaction was negative. A study of the metabolism was made by Dr. Robert Pollock with the following results: The basal metabolism rate was -8 per cent. "Circulation, including heart, arteries and kidneys, fairly normal." "There is some slight evidence of arteriosclerosis beyond his years gleaned from the superficial arteries." "Blood pressure 140-90, 136-84; urine, specific gravity 1.013, light amber color, acid reaction, no albumen, sugar or acetone bodies, sediment negative; hemoglobin, 100 per cent; R. B. C., 5,200,000; W. B. C., 11,800. Differential count: P. M. N., 59 per cent; lymphs., 30 per cent; L. monos., 5 per cent; Trans., 4 per cent; Eos., 1 per cent; Baso., 1 per cent. No abnormal cells. The blood chemistry was as follows: Blood sugar, .09 per cent; sugar tolerance, normal; creatinin, 5 mgs. per 100 cc.; urea nitrogen, 25 mgs. per 100 cc.; uric acid, 3.3 mgs. per 100 cc.; alkali reserve, 43 cc. per 100 cc. X-ray of sella turcica showed a sella well within the bounds of normal." This shows a slight kidney retention of the creatinin, and also a slight reduction of the alkali reserve that could not be accounted for. Facilities were not at hand for a blood viscosity determination. An examination of the patient's family gave nothing startling in the line of evidence towards a family tendency, yet bears reporting. One daughter on the right showed what seemed to be slight thickening of the posterior canal wall; a second daughter, the isthmus on the right narrowed anteroposteriorly; a third, thickening posteriorly and deeply. A son also showed some anteroposterior thickening on the right side. An older brother of the patient had normal canals. Wife's canals normal.

The pathologic report of the specimen, by Drs. Grant and Wilson, is as follows: One portion showed "an osseous reticulum containing some slight amount of unchanged fibrous tissue. The osseous tissue itself contains a normal number of osteoblasts. In the few strands of fibrous tissue present, a

very small number of fibroblasts may be noted. A second portion consists essentially of fibrous tissue with considerable numbers of fibroblasts present. There is a moderate amount of calcification present arranged in minute areas and in minute lamellæ like structures. No osteoblasts or osteoclasts were found. This condition seems to be a proliferative periostitis." (Photomicrograph.) This growth can be called an exostosis just as any bony growth from a long bone. The process may be different in that (as has been shown) the tympanic plate is a "membranous" bone and not cartilaginous. According to MacCallum, "the membranous bones are produced by a change in the function of certain cells which acquire the power of laying down an intercellular matrix, in which they bury themselves, and which in time becomes calcified." The microscopic examination shows the various stages of such a process, from fibroblasts in fibrous tissue to osteoblasts in osseous tissue. This is to be expected, since the process had been progressing up to the time of the second operation. We have here, I should say, an idiopathic case with no evidence of local or constitutional irritation or basis of the new growth except the prolonged sea bathing.

Prehistorically considered, this subject is most fascinating. The literature naturally would be somewhat scanty, but I desire to make a resumé of what has been found before reporting the material of the Anthropological Department of the San Diego Museum. Blake, in 1880, examined part of the skulls in the Peabody Museum of Archeology and Ethnology in Cambridge. They were specimens from the stone graves of the mound builders of the Cumberland Valley, Tennessee. Of 195 skulls, 36 showed exostoses, 12 in both canals, 9 in the right and 15 in the left. Of the 54 total growths, 42 were on the posterior wall and 12 rounded, principally on the anterior wall. These skulls presented no evidence of syphilis. Ten of the cases came from one distinct locality and 6 from another, pointing to a racial if not a familial tendency. He also investigated 108 California crania, finding five possessing exostoses in one or both canals. He reported five cases out of six South American crania (Seligman), two out of nine Marquesas Island skulls, and one Fox Indian (Welcher), two from Peru (Turner), and six in 334 Peruvian crania almost

uniformly at the end of the canal and anterosuperiorly or posteroinferiorly (Wyman). A continuation of his research gave six exostoses in 37 crania, all from one mound in Arkansas, again suggesting a family tendency. Here, too, there was no evidence of syphilis, the long bones being examined for that condition also. Jackson found 25 cases among the 450 North and South American skulls in the Hunterian collection of the Royal College of Surgeons, the majority being from locations near the sea. He states that 25 per cent of the skulls from the prehistoric mounds of North America show this condition. Virchow found eighteen cases in 134 Peruvian skulls. In a personal communication Dr. Bruno Oettking of the Museum of the American Indian states that in their collection there are 88 skulls from San Miguel and 62 from the other Channel Islands. In the entire series two show exostoses of the aural canal. This gives a frequency of 23 per 1000 in the San Miguel crania, and 13 per 1000 for the whole series. "The exostoses are pea shaped, of solid texture and symmetrically situated at the anterior and posterior walls of the porus acusticus externus, thus corresponding to the endings of the originally incomplete annulus tympanicus. The porus is almost completely occluded; the pea shaped exostoses are flattened at their point of meeting without, however, producing coalescence." With Dr. Oettking's permission I wish also to give his conclusions derived from the Jesup material (North Pacific) in the American Museum of Natural History:

"Although exostoses occur at an increasing rate in the different modes (of deformation of the skull) while the undeformed have none, I have myself not come to a final conclusion as to a connection between deforming influences and the exostoses, since these happen also in undeformed skulls of other series. I should like, furthermore, to call your attention to the fact that no exostoses have been found in the immature (juveniles and infantiles), which is according to R. Virchow (*crania ethnica americana*), of some importance in judging the causality of the phenomenon." The figures are as follows: Three types of deformations were examined. The lowest figures were 2.3 per cent among males only, or 23 per 1000. The highest was 32.8 per cent among males and 15.4 per cent among the females of the same group, an average of 23.4, or

23 per 1000. In another type the females were twice as frequent in occurrence as the males, with a final average of 1.9 per cent.

The specimens to be reported are those of the Anthropological Department in the San Diego Museum. They were selected by Dr. Hrdlicka from the prehistoric cemeteries along the coast of Peru and mountains near the coast. In all, 4800 crania and parts of crania were examined in order to collect an exhibit of cranial pathology. Twenty-six deformed skulls showed five cases of exostoses in the canal and one in the middle ear just below the eustachian orifice. All of them showed more or less anteroposterior narrowing of the canals, especially on the left. Fifty-two crania chosen to show other lesions regardless of exostoses presented five occurrences. In one the external table of the mastoid had been destroyed by some pathologic process and a large cell uncovered. This contained a pea shaped rough exostosis about 2 mm. in diameter. Twenty-two temporal bones and 2 skulls were collected specifically to show this condition. All the various types described by the authors of our present day literature were found in these remains except those with a thin bony pedicle. These may have been present during the life of the individual, but the natural course of decay and maceration would have destroyed the attachments and thus the exostosis become lost. Only one specimen showed involvement of the floor, while four, in addition to growths on the tympanic plate, had small scale or barnacle like exostoses on the roof, a total of six separate excrescences. The total number of distinct exostoses was 84 from 46 temporal bones (including skulls) out of the 4800 crania examined. If we regard each temporal bone as coming from a different skull there was a total of 34 crania. Forty of the 78 growths limited to the tympanic plate extended to the annulus from the outer end of the canal, or over 50 per cent. In many others the canal was so occluded that definite information could not be obtained in this regard. They were equally distributed between the anterior and posterior walls, and all except seven were situated at the sutures, tympanomastoid or tympanosquamous. The growths not at the sutures were never single, but exostoses existed at those spots simultaneously. Four consisted of a diffuse thickening of the

canal wall. The number of growths varied from one per cranium to four per temporal bone. The majority were roughly oblong and extended the long way of the canal, taller at the outer end. The very small minority, in fact, only five, were round or pea shaped. Reduced to figures, there were: 17.5 distinct growths per 1000 skulls; 9.5 temporal bones involved per 1000 skulls; 7 skulls involved per 1000 skulls.

The only suggestion as to relative prevalence among the males and females may be derived from the 52 miscellaneous crania. Four males were affected and only one female. Considering the low percentage reported from the clinics and private practice of the present day, and postulating the premise that both in present life and in the selection of the exhibit an equal number of cases may not have been reported, we may conclude that this condition was more prevalent in prehistoric times. Contributors to the literature of this phase of the subject have given figures in support of this conclusion. Present day statistics, it may be noted, refer to the per cent of cases of aural disease, while those of prehistoric man are those of crania in general, irrespective of the aural condition.

The illustrations are photographs of some representative temporal bones selected to give a general idea of the exhibit.

As is well known, the long axis of the aural canal is not a straight line, the membranocartilaginous portion being directed inward and slightly upward and backward, and the osseous portion inward, slightly downward and forward. The junction of the two makes a rounded angle projecting into the lumen of the canal, forming a ridge from which each division descends. Immediately anterior to this angle is the mandibular joint (Politzer), and it is a well known fact that in mastication the movement of the lower jaw produces a change in the lumen of the canal, and that violence applied to the mandible at times causes fracture of the tympanic plate. Bruhl's explanation in otosclerosis that the stress due to the pull of the tensor tympani muscle accounts in many cases for the initial bone changes about the oval window, and Gray's belief that molecular stress on the bone in the same situation by movement of the stapes may in some way be productive of the otosclerotic process, seem both ingenious and plausible. In a similar manner, the writer believes irritation to the aural

canal due to mastication to be a contributory etiologic factor of aural exostoses. Evidence of this may be gathered from the investigation of the life and habits of early man. Antedating and even during the use of flint and obsidian tools, prehistoric man surely depended upon nature's equipment. While he no doubt was early in possession of deft hands, it seems only natural to assume that the teeth became a third hand, as it were, bringing the jaws into strenuous use, not only in masticating the tough uncooked foods, in cracking hard shell nuts, and assisting in preparing other necessities of life, but also as a weapon of defense. In most of the prehistoric crania examined the greater involvement is at the point of union of the cartilaginous with the osseous canals and along the suture lines. At the former point there would be not only the rounded eminence to receive special stimulation from any form of irritation within the canal itself, but the molecular stress exerted by such use of the mandible must have been considerable at this portion of the canal as well as along the unfused or weak tympanomastoid and tympanoquamous sutures, resulting in irritation of the more susceptible areas of the tympanic plate mentioned previously.

Referring once again to the literature on otosclerosis as being fruitful in its suggestions, I wish to quote from Gray's latest publication on the subject, taking the liberty of substituting the word "exostosis" for "otosclerosis." He says: "The other general aspect of the problem is that the majority of individuals never do suffer from exostoses, no matter how badly or from whatever cause their general health becomes affected, or whether they suffer from some local disease of the ear, such as suppuration, middle ear catarrh, etc., or not. Now it appears to the writer that, viewed from this point of view, the logical conclusion to be drawn is that the cause of exostoses—that is, the condition without which the disease cannot occur—is to be found in the organ of hearing itself, and, further, that this condition exists in the organ of hearing of certain individuals, and in these individuals only. From this point of view, which the present writer believes to be the correct one, exostosis is idiopathic. That is to say, the disease occurs in people who have an inborn tendency to it, and that this is the only constant factor in the etiology. No doubt dis-

turbances, either locally in the ears or constitutionally in the bodies of these individuals, may precipitate the onset of the disease, but no particular one of these disturbances need be present and in many cases they may all be absent. The single constant factor in the innate tendency to the disease and the fact that hereditary influences are evident in many cases is strongly in support of this view." This "constant factor" can be postulated, in my opinion, from a consideration of the evolution of the organ of hearing. It is a fact, well known by biologists (as mentioned by Gray in his book "Otosclerosis") that the first division of the hearing apparatus to develop was the static labyrinth, as shown by the fish. Later, as the animal kingdom became amphibious, the hearing labyrinth appeared. Still higher in the scale we find the bony canal developing up to its present adult form in the genus homo. Can we not answer our problem by using the term "atavism"? Here in this disease is an attempt on the part of the organism to return to its primitive state, an attempt to obliterate the hearing and the static mechanism in the reverse order of its development. This would be the natural order of retrogression, the latest developed being the first to suffer from the latent tendency or rather capacity of reversion that lurks in all forms of life, human or otherwise. The canals of our ancestors would be, in the light of this fact, less stable than those of our immediate predecessors or fellow citizens. This may be regarded as one of the factors accounting for its much greater prevalence in primitive man. Those cases attributed to purulent processes in the middle ear and those in which the condition arises apparently spontaneously can be reconciled on this common ground. Why do not all cases of O. M. P. C., with or without polypi, develop exostoses? The purulent process merely calls into action the latent tendency of the organism. The many other factors, rheumatism, syphilis, gout, etc., may act in the same manner. But underlying the whole process we can postulate the theory I have advanced. All the divergent clinical evidence that has been brought to light since the earliest discussion of the subject can thus be reconciled—i. e., the many etiologic factors, the absence of any such, the hereditary element and the sporadic appearance in an individual with no apparent hereditary taint.

SUMMARY AND CONCLUSIONS.

Exostoses are relatively a rare condition in the aural canals at the present time.

They may exist along with some irritative condition in the ear, inflammatory or noninflammatory. Constitutional disturbances have also been found to exist coincidentally. These may all be absent and the condition linked with a hereditary, congenital or developmental factor.

Practically all the exostoses found exist along the lines of union and of the tympanic plate and the rest of the temporal bone. It is in these two regions that the bony canal is developed most rapidly from the annulus. It may be postulated that these ends of the annulus that proliferated the more rapidly are more susceptible to irritation of any sort.

An additional factor in the development of exostoses along the suture lines at these more susceptible areas is the irritation due to mastication acting on what are in many instances weakly fused lines of union.

The case reported offers little light on the subject of the etiology except that excessive sea bathing may have been an exciting factor. The process microscopically and pathologically considered was a "proliferative periostitis." Accompanying the exostoses were an intumescent rhinitis, a markedly deviated septum and an O. M. C. C., conditions which, like those complicating an otosclerosis, may often be neglected or even overlooked. In all cases coexistent pathology in the head should be corrected. The general condition of the patient should be investigated at the time of examination and with regard to the circumstances at the onset of the aural symptoms. In this way many interesting and relevant facts may be uncovered.

Prehistorically considered, aural exostoses were more prevalent in primitive man. The etiologic factor postulated in this regard is the excessive use of the teeth, reacting on the more susceptible areas before mentioned (still more susceptible because of the earlier stage in evolution) producing lines of increased stress and even slight motion at the suture lines, very often weakly fused or largely unfused.

In view of the many causes given, we can conclude that the fundamental factor has not been discovered. I wish to advance the theory of atavism as a possible answer.

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VIII.

CONSIDERATION OF THE RADICAL MASTOID.

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The object in reporting radical mastoid cases is again to emphasize the seriousness of chronic suppuration and to impress the full responsibility that otologists bear in the education of the laity. It is not the writer's intention to dwell on the local treatment of chronic suppuration. In reporting the features of fifty cases, it is at once obvious that there was no choice between treatment and operation. The radical mastoid operation has been greatly stigmatized by otologists, but when one considers the early technic employed in radical surgery it is easy to understand why it was so universally condemned.

In choosing this subject, the writer has been prompted partially by the increasing interest in the radical mastoid manifested by students, especially those who have practiced otolaryngology for some years. It is possible to stretch the imagination to see the day when this operation may be more universally done and with very little anxiety on the part of the operator. Untoward accidents may happen at times, but after experience on many mastoids, both on the cadaver and the living, one must progress in his technic or he will consistently fail.

The compulsory examinations of the late war, during the draft, brought to notice many cases that would otherwise have escaped observation. Every other ear case brought to the attention of the Advisory Board was one of chronic suppuration. Since the close of the war, the writer has been active in the U. S. Public Health Service and has been surprised at the large number that require operation before a cure can be effected. A large percentage of these cases applying today are due to the epidemic in the cantonments and to trauma produced by explosion of shells and concussions at the front.

Nature itself has pointed the way to treatment of these cases. One now under observation illustrates this most forcibly. In this chronic otorrhea of cholesteatomatous character had performed a complete radical operation, with the exception of enlarging the concha. The cavity proper is as pretty and clean as any performed by human hands.

The indications for operation may be briefly considered, subjectively and objectively. There may be a history of headaches confined to the involved side, vertigo, foul discharge, tinnitus, defective hearing and impaired general health. Otoscopic examination may reveal foul discharge, a mastoid fistula, granulations, cholesteatoma, the presence of sequestra, exostosis, or necrosis about the tympanic cavity. Any one of these symptoms, if manifested in sufficient intensity, may warrant operative interference.

COMPLICATIONS.

The complications demanding surgical interference are acute exacerbations, meningeal infections, labyrinthitis, sinus thrombosis, facial paralysis, retropharyngeal and deep cervical abscesses.

Essentials of Surgical Technic: Much of the success of the radical operation depends on the mental condition of the surgeon at the time of operation. He must be able to think clearly and concentrate his mental efforts upon the physical requirements. Good tactile sense and visual acuity are necessary attributes, of course, and good judgment must be exercised.

Instruments: On the whole, the earlier instruments, the gouge and curette, have proved to be the most practical, although some prefer to use an electric burr. By exercising perfect control of the gouge and directing upward all motions of the curette, it is found that the instrument for the protection of the facial nerve is unnecessary when removing the facial bridge. A good reflecting light is indispensable in doing the radical operation.

Anesthetization: In administering the anesthetic, keen watchfulness on the part of the anesthetist is important for the successful termination of the operation. Close observation of the face on the involved side should inform the surgeon of

any trespassing on the facial nerve. In pulmonary conditions ether should not be used; nitrous oxid is the anesthetic of choice.

SALIENT POINTS TO INSURE SUCCESS IN THE RADICAL OPERATION.

1. The dural plate, whether over the tympanum or the antral area, should be removed if necrosis is suspected. Whenever cholesteatoma is present these plates are always involved and necessitate removal.

2. After removing the bridge, a slight amount of "overhang" of the facial ridge, just above the stapedia area, is allowed to remain until near the completion of the operation in order more carefully to protect the stapes.

3. In curetting or sponging the tympanic cavity, all movement should be directed from the floor to the vault or vice versa. In directing the movement in this manner there will be little danger of fracturing or dislocating the stapes, which may introduce infection into the labyrinth, or ultimately cause impairment of hearing.

4. In curettage of the eustachian tube, greater force should be directed forward and above and less posteriorly, because of the near proximity of the carotid artery. A reverse or ring curette is the instrument of choice here.

5. The anterior posterior diameter of the tympanum should be sufficiently enlarged to allow ample room for ventilation and drainage. This may be done by removing the overlying edge of the internal surface of the posterior canal wall, and reducing the convexity of the bone of the glenoid fossa in front.

6. The cells about the processus cochleariformis and those overlying the eustachian tube should be thoroughly exenterated.

7. The inferior wall of the tympanum or hypotympanum should be reduced so as to prevent the formation of a pocket. It should be especially lowered when the disease of the mastoid extends back to the tip.

8. An adequate flap of the concha is necessary for post-operative treatment, in order to permit ventilation and tone vibrations to be more readily conveyed to the internal ear. From a cosmetic standpoint, the flap should be broad at the base and more narrow at the top, although in women the ear

is later covered by an abundance of hair. Where the cavity of the mastoid extends well back into the infrasinus area or tip region, a fairly large flap is preferable for the ready inspection of the cavity, although a small pharyngeal mirror may be used to aid in this.

SURVEY OF CASES AND COMMENT.

Bilateral suppuration, as shown by these cases, assumes a fair proportion. Ten of the fifty had a double otorrhea. On four of them a double radical operation was performed. Two cases which were skin-grafted were able to hear a moderate whisper at from sixteen to eighteen feet. One of these had previously been a student at a deaf institute. The mother of this patient returned to the hospital for a certificate to allow her boy to enter the public school. A third patient improved so much in general health and hearing that the other ear was operated on; the result, however, was not so good with the second ear, partly on account of some necrosis coming from the dural plate, which was overlooked. This patient was one of the earliest cases. A secondary operation has been advised in order to eliminate completely every vestige of disease, as the hearing does improve when the ear is dry and aided mechanically by the use of a plug. The fourth of these bilateral radical cases was a former service boy, operated upon at one of the U. S. Public Health hospitals. The improvement here in the first radical was so marked that he insisted on having the other ear operated also. Three of the series had previously had simple mastoidectomies. In one case this had been the operation of choice as a conservative measure; and the continued suppuration following this necessitated a radical operation. The other two patients had very foul discharge and a high degree of impairment of hearing. The canal walls in both instances had collapsed so that no view of the tympanum could be obtained. In other cases it has been observed that whenever a simple mastoid has been performed and the canal wall allowed to collapse the insufficient ventilation of the tympanic cavity results in chronic necrosis of this cavity. In both instances after the radical, pus was excessive, so that the posterior wound broke down, forming a permanent fistula, the cicatrices from the former

operations with insufficient suturing probably accounting for this. The lesson to be learned from this is that the periosteum should always be sutured in addition to the closure of the skin. The ears later became perfectly dry, and the audition of the patients was much improved.

In another case, a patient thirteen years old had had a discharge since two years of age. She had been under persistent local treatment for the last two years, with no improvement. Her hearing was very poor. A radical operation was performed seven weeks ago. No skin graft was employed because of the profuse discharge at the time. This case well illustrates, however, how ineffective local treatment may be in some instances if one does not understand the subject. One month after the radical operation, during the absence of the writer, the ear was again examined and found to be filled with granulations and a profuse foul discharge. This could have been avoided had the patient been treated with proper diligence and after care. After six weeks of persistent careful treatment a dry cavity was secured. With the noise apparatus in the other ear this girl was able to hear moderate voice at twelve feet. The general health of the patient improved so that there was a gain of nine pounds in the last month.

In this series the youngest patient operated upon was three and a half years of age; and the oldest, fifty-five. With the child, there was some hesitation about doing a radical operation, but the cavity was found to be filled with cholesteatoma with extensive necrosis, so that it was imperative. The case was skin grafted and resulted in complete cure except for an occasional tubal discharge coming on with an acute rhinitis.

Recently the writer performed a radical mastoid operation on a child of two years. This patient appeared to have a subperiosteal abscess with a complete congenital canal atresia. The mastoid and middle ear were filled with pus and cholesteatoma necessitating a radical.

Recently two cases have been observed in children slightly over two years of age, both of them requiring a radical mastoid operation. One of these was admitted to the hospital with meningitis, due to the extension of mastoid

necrosis. Cholesteatoma was present in both cases; this form of infection evidently comes with the inception of the primary otitis, and persists until it is either overcome by the surgeon or it overcomes the patient.

One case of the series was complicated by pulmonary tuberculosis, which was not recognized until the administration of ether, which provoked a persistent cough. The pulmonary condition was no doubt aggravated by the ether. This patient died in a sanitarium four months later. In clinical cases one is apt to attribute depleting symptoms to otorrhea. Whenever possible an examination should be made to rule out any complicating diseases.

In all the writer's experience, syphilis was suspected in only one case of mastoiditis. This occurred in an acute infection. The distinctly gelatinous character of the mastoid bone in this instance prompted a Wassermann test, which proved to be four plus. The resolution in this case, however, took place in the usual time, and later the patient was referred for syphilitic treatment. In none of the series was there evidence of syphilis, although a positive infection does not necessarily contraindicate an operation.

Two cases of the series of fifty were complicated by epidural abscesses. In both instances extensive pathologic changes had taken place for some time, without any special discomfort to the patient. The first of these illustrates how dangerously near one can approach a fatal termination by adopting a watchful waiting policy. The writer was well acquainted with this patient and tried his utmost by local treatment to avoid any surgical interference. This man was forty-six years of age and had had a discharge ever since he could remember. The discharge increased, with an acute attack of rhinitis. This was followed by a sensation of heaviness about the same side of the head. No temperature or tenderness were present, but after two weeks of daily observation, the head symptoms persisted, with three nights of insomnia. On the morning following the third night of sleeplessness, the patient complained of an acute pain behind the eye on the side of the involved ear. A diagnosis of epidural abscess was made because of the coincidence of the eye symptoms, and the patient was operated upon that same afternoon.

The destruction of bone in the mastoid was almost unbelievable. The sinus wall was completely necrosed. When attempting to pass the probe into the aditus to find the antrum it was necessary to slightly displace the projecting and exposed lateral sinus and while doing this twice a couple of drams of cerebrospinal fluid escaped. The spinal fluid apparently came from the region of the internal auditory meatus. The sinus was closely approximated with the exposed dura. The tympanum was filled with debris and granulations. In removing some of the granulations and edges of the diseased bone about the dura, a teaspoonful of pus escaped. The facial nerve was exposed by disease and twitching was observed during the operation when sponging the tympanic cavity. A spinal puncture was done immediately following the operation. Examination revealed a cell count of 80 per cubic mm. No complications developed. Undoubtedly the high spinal cell count was due to the intimacy of the abscess with the dural sheaths, resulting in a protective form of meningitis. The ear subsequently became perfectly dry and hearing was much improved.

The other case occurred in a boy of seven years, who was unable to describe his symptoms accurately. During the day he had been at play as usual, but at night he complained of pain about the head. A chronic suppuration from which the child had suffered, made the parents suspicious. A radical operation was performed by the usual technic. The cavity was apparently one of those of a constricted type that so often follow long suppuration, where there is sclerosis and proliferation of bone. Only the habitual practice of following up the smallest bit of granulated tissue led the operator to discover the epidural abscess cavity. In this instance the spinal cell count was normal. The patient refused a subsequent skin graft, which was advised several weeks later. There is still an odorless serous discharge from the tubal area and the region where the epidural abscess had formed has failed to granulate. The boy's hearing, however, has considerably improved.

The coincidence of facial paralysis with chronic suppuration must be considered as a positive symptom of bone necrosis, although a facial palsy may be the result of other conditions.

When the facial nerve is exposed by disease, it is usually evident along the internal surface of the posterior wall or where it comes to the surface as it crosses the tympanic cavity. In two cases of this series there were large sequestra, one involving the cochlea, semicircular canals and petrous portion of the temporal bone. In this case there was no paralysis prior to the operation, but in removing the sequestra the facial nerve was unfortunately destroyed. In the second case the facial nerve was exposed through the entire route of the tympanic portion of the posterior wall with no palsy and none following the operation. In the after treatment the facial nerve was plainly seen in its course. Cases with facial twitch occurring during the operation are usually followed by temporary paralysis a couple of days later.

In the last two cases in which the writer has exposed the nerve during the operation he has removed the packing after twenty-four hours and replaced it by a light dressing, instead of waiting five days, and to this early removal he ascribes his success in preventing a temporary facial paralysis. In three other cases where the packing was allowed to remain for five days the purulent inflammation produced a perineuritis with a facial palsy, so that the patients were unable to regain the function of the nerve until after five to ten weeks. In none of these cases, however, was there any permanent paralysis.

In the practice of the writer, three patients have been seen with partial ankylosis of the inferior maxillary following a radical mastoid. Two of these were operated upon by other surgeons; one was kept under observation for a little more than a year, when the ankylosis disappeared without further intervention. The last patient was entirely free of the impairment in three weeks. It has been observed that this complication follows a fracture or slight exposure of this articulation when trying to reduce the convexity of the anterior wall of the canal. Should this accident happen it is far better to purposely expose a fair sized area of the glenoid fossa so as to prevent synovitis and ankylosis.

Another patient was admitted to the hospital with a four day history of acute exacerbation with sinus thrombosis. There were three chills, lasting ten minutes each. The temperature range was from 103 to 106 deg. F. Upon opening

the cavity, the dural sinus plates were completely broken down. A large clot was visible in the lateral sinus. The pressure exerted by this clot was sufficient to cause a depression in the cerebellum about the size of a walnut. The patient's pulse rate, which was from 50 to 60 per minute, caused a suspicion of some cerebral lesion. In this instance it is believed that simply the pressure of the brain tissue was sufficient to cause the interference with the circulation, resulting in the very low pulse rate. Because of the serious physical condition at this time, only a resection and ligation of the jugular was done with curettage of the lateral sinus,—the radical mastoid being deferred until a month later. The foul discharge had continued from the diseased tympanic cavity. A skin graft was applied, and the cavity became perfectly dry with improved hearing.

In two other cases of the series the lateral sinus was very large, exposed by disease, and lay against the posterior wall so that it was impossible to remove the facial bridge except by working from the tympanic side.

In two more cases in which the radical mastoid was performed the lateral sinus wall was found to be so thin that at the time of the removal of the first dressing five days subsequent to the operation there was a profuse hemorrhage. In the one instance the hemorrhage was repeated during several weeks upon succeeding efforts to remove the gauze. Both cases ran a high temperature for several days, typical of sinus thrombosis. A blood culture was made with negative results. Later the temperature fell to normal.

These four cases furnish a warning to those who advocate treatment by suction for the cure of chronic suppuration. A thin or exposed sinus wall may easily be infected or injured in this manner.

SUMMARY.

Reviewing this series of fifty cases; there were twenty-three operated upon with a primary skin graft. Six of the total number still have a discharge from the eustachian tube, four of them children. Only one case of the series has evidence of a necrosed dural plate, which was mentioned in one of the preceding paragraphs.

COMPLICATIONS EXISTING PRIOR TO RADICAL MASTOID.

Epidural abscess	2
Sinus thrombosis	1
Sequestration	2
Facial nerve exposure.....	3
Secondary mastoiditis	3
Labyrinthitis (suppurative)	1
Acute exacerbation	12

POST-OPERATIVE COMPLICATIONS

Erysipelas	2
Pneumonia	1
Temporary facial paralysis (duration three to eight weeks)	4
Exacerbation of pulmonary tuberculosis.....	1

In this connection several points should be emphasized. To begin with there was a large percentage of cases in which there was an acute exacerbation, necessitating the radical operation. In such cases a primary radical may be safely performed if the patient's vitality permits. Only three died and in none of these was death directly attributed to the operation. One of the three cases was complicated by pneumonia. A second patient came to the hospital with symptoms of labyrinthitis and died several days later of meningitis. The third case died of pulmonary tuberculosis four months after the operation.

In a large number the radical operation was imperative because of the complications. The risk involved was very slight. In none of the fatalities was death directly due to the operation. In only one of the entire number did the discharge from a necrosed area continue after operation, and this was one of the early cases of the series, due to the failure to remove the diseased dural plate. In twenty-seven of the fifty cases the dura was either partially or almost completely exposed either purposely or by disease. This large percentage of dural exposures doubtless accounts for the dry cavities obtained.

In most instances the hearing improved, the exceptions being a few that had unusual hearing before operation. The contention has been made by a number of otologists that the

improvement is only temporary. The writer maintains that by careful after treatment, immediately following the operation, keeping down the granulations and preventing adhesions from forming the surgeon can do much to prevent subsequent impairment of hearing. Later treatment also is important. It consists in removing all ceruminous and desquamating epithelial material as it forms, followed by the application of albolene. The local application of the plugs or emollients restores the hearing, if temporarily diminished.

The general health of the patient is invariably improved, as manifested by an increase of weight and the return of a healthy color to the skin.

CONCLUSIONS.

1. The risk to life is almost negligible.
2. Age is not a factor in considering a radical operation. The indication depends on the symptoms and the condition of the patient.
3. When the operation is properly performed, the hearing is improved unless there is some disease of the receptive mechanism. A radical should be advised where the hearing is very much impaired to improve the audition.
4. The operation is rarely followed by permanent facial paralysis.
5. The application of skin grafts increases the percentage of cures, materially lessens the time of resolution and aids in the preservation of hearing.

11 EAST 48TH STREET.

IX.

CASE OF POLYARTHRITIS COMPLICATING MASTOIDITIS. OPERATION. RECOVERY.

BY DUNBAR ROY, A. B., M. D.,

ATLANTA.

Focal infections as a cause of arthritis seem now to be an established fact. However, mastoiditis, whether acute or chronic, seems to have received but little mention as one of these causes if we may judge from the infrequency of reported cases.

While various conditions such as glycosuria, convulsions, and other nervous phenomena often occur in the course of acute infections of the ear and while there seems to be no good reason why rheumatism, arthritis and neuritis should not occur from acute and chronic ear affections, yet the complications which do occur are the conditions which are usually denominated as pyemic.

In looking over my own personal histories of aural diseases for the last twenty-five years the writer has been unable to find any other case even resembling the one here reported and the literature examined would certainly lead one to the conclusion that such a complication is exceedingly rare. What few references as have been found have been reported in this country so that one is forced to the conclusion that such complications are so frequent as not to be worthy of mention or that the same has not been observed.

Case history: Jack J., white, age 4. Strong, healthy looking child, giving only the history of repeated colds in the head.

Examination shows tonsils very much enlarged and also the presence of increased amount of adenoid tissue. Operation advised and on February 2, 1921, at Georgia Baptist Hospital both tonsils and adenoids were thoroughly removed by my associate, Dr. Murdock Euen. Convalescence was uneventful and in a few days the child was out and immediately began to improve.

On March 5, 1921, nearly a month after the tonsil and adenoid operation, the patient began to complain of severe pain in right ear and two days later the left ear also began to pain.

Dr. Equen was called in consultation and finding both ear drums red and bulging, under chloroform anesthesia, these were freely incised. This was followed by a free discharge of mucopus from both middle ears, all pain being relieved and the temperature being practically normal. Both ears were kept irrigated with a hot carbolized solution. The patient seemed apparently well. Appetite good and sleep uninterrupted. There was no pain, tenderness or edema over the mastoid. With the exception of the profuse discharge there were no other complicating symptoms.

Smears taken from the discharge showed the presence of both staphylococci and streptococci organisms. To all appearances the case was progressing nicely and healing of the middle ear seemed to be taking a normal course. The only exception to this was the continuous free discharge of mucopus.

On March 9th, four days after the beginning of the middle ear discharge, the patient was seized with an acute arthritis of the finger, knee and ankle joints on both sides. This was accompanied by a sudden rise in temperature to 102 F. with intense pain on moving these joints and pain even without movements. Patient was unable to sleep day or night without anodyne. The usual remedies for this condition were tried without success and after a consultation we decided that there was a toxic absorption from the middle ear indicated by the very profuse discharge and while there were no typical mastoid symptoms it was evident that this profuse discharge could only be coming from the mastoid antrum and cells. The urinary examination showed nothing abnormal. No blood count was made as we did not deem it necessary.

Under the circumstances we decided to open the mastoid. Accordingly on March 12th, one week after the membrana tympani was punctured, the right mastoid was operated upon, this being the first ear involved and from which the discharge was most profuse.

A simple mastoidectomy was performed. On entering the mastoid antrum pus was found and a few adjoining cells in-

volved. These were rapidly cleaned out and a free communication made with the middle ear. The wound was closed entirely and a small wick of iodoform gauze placed at the lower end of the wound.

In one week's time all discharge had ceased and the mastoid wound was entirely healed. There was only a slight amelioration in the joint symptoms and the discharge from the left ear was now very profuse. Consequently one week after the first operation the left mastoid was opened and almost identical findings resulted. The wound was closed in the same manner. It took only twenty minutes for each operation.

For a few days there was considerable discharge from the external canal and also from the lower part of the wound. However, this rapidly disappeared under treatment and in less than two weeks the mastoid wound was entirely healed and the middle ear was dry. The hearing in both ears was normal. Two days after the operation all arthritic symptoms in the joints disappeared and the patient has had no further trouble. In addition to the double mastoidectomy autogenous vaccins were made from the middle ear discharge and five injections were given in increasing strengths.

As has been mentioned previously, it is surprising how few cases of a similar character have been reported. While my tabulated report is perhaps by no means complete the writer, has appended an abstract of all the cases which he could find and which will at least aid in further research along this line.

Purulent Pneumococcic Arthritis in Children. Dudgeon and Brausen, *Lancet*. 2:316, 1903: Five cases are reported, only one of which is related to otitis.

Case 11.—A boy, 6 years, admitted March 23, 1903. The patient had been ill for three weeks with earache and subsequent otorrhea, when on March 16 he complained of swelling in the left knee joint, followed on the next day by similar affections of the right hip and wrist. There was no history of rigor, convulsion, or any other symptom of note. The patient on admission appeared to be very ill and lay curled up in bed with all his joints flexed. He had a troublesome dry cough and was slightly delirious, though his fever was moderate.

Nothing abnormal was to be discovered in the lungs or heart. The left knee joint was swollen, red, hot, shiny and fluctuating, while the right hip and wrist appeared to be in a less advanced state of inflammation, and this in the latter seemed not to involve the joint, but to lie superficial to it. Urine was normal. The knee joint was opened and a quantity of thin pus and flakes of fibrin were evacuated and a similar result attended the opening of the hip joint. Little benefit resulted from the operation though the wounds progressed favorably. Fever continued high at night with morning remissions and with gradual loss of strength, but without specific complications; the child died from asthenia twenty days after operation. No post mortem was allowed.

In this series of five cases, the exciting cause of the arthritis in three was found to be "pneumonia," "bronchitis" and "otorrhea."

A table of Netter, quoted by Muir and Ritchie, gives otitis media as a source of infection (arthritis) in children in 29 out of 46 cases collected, bronchopneumonia in 12, meningitis in two, pneumonia in one, pericarditis in one, and pleurisy in one. No case of primary arthritis occurs in the list.

Mastoid Cases at Camp Sherman, Christian R. Holmes. *Ann. Otol., Rhinol. and Laryngol.* 28:1, 1919.

In a series of forty cases reported of mastoid diseases with complications one is given as double.

Case 34.—Evans, double otitis media. Simple mastoidectomy left side, March 14. Temperature 106.5 (rectal) at operation. Fell to normal and remained so for about a week, when inflammation developed in left knee, with moderate rise of temperature. Capt. Sturgis aspirated. Contained mucopurulent fluid. April 3 it became necessary to make a simple mastoid operation on the other ear, at which time the knee was aspirated again. Fluid dark and cloudy.

Infective Arthritis Complicating Otitis Media. W. P. Eagleton, *Arch. Otol.* 34:483, 1905.

Case 11.—Male, aged 24. Previous history negative. Never suffered from rheumatism. Otitis media suppurative following coryza. Paracentesis made under nitrous oxide.

Very profuse discharge. Temperature 101-103 degrees F. One week later pain in right knee, accompanied by only slight swelling. The next day, the left knee was similarly affected, and later both ankles, accompanying which a distinct pericardial or possibly an endocardial murmur could be heard, which was not present on the previous day. Gradual recovery.

In true infective arthritis and that complicating osteomyelitis, the mortality is very high, while the mobility of the joint is almost sure to be seriously impaired, if not altogether lost. The author found only 79 cases reported pneumococcic arthritis, of which 60 per cent (48) died.

Case of Mastoiditis Complicated by Suppurative Arthritis of the Shoulder. Erskine. *Ann. Otol., Rhinol. and Laryngol.* 25:1035, 1916.

The mastoiditis developed after an attack of influenza. The patient had been confined to bed for a week and then after having had an earache for a day and a half the ear was examined and a hemorrhagic bulla was found on the drum membrane. The drum was incised and drained. The patient improved for five days, then again suffered with earache. After a week, a culture showed streptococcus brevis. A mastoid operation was performed about which there was nothing unusual. The man was over six feet tall, below par, weighed 147 pounds.

On coming out of the anesthetic the man complained of pain in the shoulder of the opposite side; he declared that it felt as if it were dislocated. There was tenderness over the front of the shoulder and the movements were painful. The next day it showed redness and three days later, when the joint was opened, the arm was very much swollen. The temperature was 102 to 103 degrees F. The man had profuse perspiration but no chills and no drop in temperature. The blood culture was negative. A general surgeon opened the joint and found three ounces of serous pus. The culture from the mastoid showed streptococcus, the culture from the pus of the shoulder showed streptococcus, as did the pus from the ear before the mastoid. Immediately after the incision of the shoulder joint the temperature went down. Subsequent course uneventful to recovery.

Dr. Opdyke told of the case of a boy with a mastoid in the right ear and arthritis in the elbow, knee and ankle joint. A year later he had a mastoid on the other side and the same involvement of the other ankle, knee and opposite elbow. The ankle, knee and elbow were not opened in either instance, though they were involved for a long time.

A Case of Pneumococcic Pyemia with Recovery. A. T. Davies and W. L. Brown; *Lancet* 2:1017-1020; London, October 8, 1904.

1. A table is given of thirty-nine fatal cases of multiple pneumococcal infection occurring at St. Bartholomew's Hospital, London, between January, 1894, and August, 1904, where the lesions were bacteriologically proved to be due to the pneumococcus alone, the probable course of events is indicated and the pathologic report appended in each case.

2. Case 35 listed girl 13 years old, shows the primary exciting cause as otitis media; complications arising are infective mitral endocarditis, rupture of tendinous cords, splenic and renal infarcts, suppurative arthritis of the right shoulder—and wrist joints; pneumococcus bacillus was cultivated from vegetations; no detailed history is given nor any nearer date than that the case came up "in the last ten years."

Relation of Infective Foci to Rheumatoid Arthritis. J. Lindsay; F. S. P. Strangenays, ed. *Bull. Com. f. the study of Spec. Dis.* 2, No. 3:106-116, Cambridge, Engl., 1908.

1. Report is based on 172 cases of rheumatoid arthritis at Royal Mineral Water Hospital, Bath, Engl.

2. The 172 cases included 138 females, 34 males; information on definite source of infection preceding onset of disease obtained in 73 females, 15 males.

3. Otorrhea present in 7 out of 138 females, in 3 out of 33 males.

Case Reports on Otorrhea. Case 48.—Married, printer, aged 43; onset of rheumatoid arthritis ten years ago; complicated by spondylitis deformans; has had discharge from left ear for many years.

Case 55.—Married woman; age 57; onset four years ago; prior to this abscess in left ear from picking ear with hairpin; intermittent ear discharge since.

Case 101.—Married woman; age 31; double otorrhea; very offensive discharge present in both ears from childhood.

Case 104.—Girl; age 12; discharge from both ears since childhood; onset at age of 7, slight discharge from left ear on admission to hospital.

Case 108.—Boy; age 11; onset 12 months ago; intermittent discharge from right ear since age of 6 or 7; discharge recurs apparently on exposure to chills.

Case Histories of Pneumococcal Osteomyelitis. Blecher; Deut. Ztschr. f. Chir. 48, no. 4:413-417; Leipzig, June 30, 1898.

Case history: 1. Boy; age 12; spontaneous left otitis media purulenta beginning November 2, 1897, subsiding two days later; November 5 painful swelling in right femur; rigor and general malaise; admitted to surgical clinic November 8.

2. Clinical findings: Well developed boy; temperature 39.9 degrees; pulse 110; skin over right femur reddened; knee much swollen; lower third of femur painful to touch; deep effusion into knee joint; left ear dry; defect of drum membrane; tympanic membrane moist and shiny.

3. Operative findings: Medial and lateral incisions made on femur; two isolated abscesses found below detached femoral periosteum, both communicate with the upper recess; bilateral arthrotomy of knee joint; drainage of pus; iodine gauze plug; dry bandage.

4. Microscopic findings: Pure cultures of Fraenkel-Weichselbaum's capsulated diplococcus were obtained both with pus drained from wound and with secretion from left ear; secretion from nose contained the same bacillus, but no pure culture could be obtained; otitis media was therefore primary cause of arthritis.

5. Postoperative course: Fever persisted until end of November though no new focus of infection or any retaining of pus could be demonstrated; pus formation decreased gradually; in December temperature became normal; granulations formed and on January 15, 1898, the wounds were well healed; after recovery there was still marked restricted motion of the knee joint and a moderately painful swelling of the lower femoral end.

Acute Otitis Media as an Early Symptom in Acute Rheumatoid Polyarthritis. C. Wolf; Arch. f. Ohrenhkl.; 41, Nos. 3 and 4; 213-216; Leipz. Dec. 30, 1896.

Case of Bilateral Otitis Media and Acute Polyarthritis. Male, 50 years old; left subacute otitis media and diminished hearing June 8, 1888; three days later slimy, flaky secretion, hearing improved, on day following right otitis media; drum membrane incised and bloody, serous, later slimy, flaky secretion drained; pain relieved; evening of fifth day rise in temperature to 38.6 degrees C; temperature on sixth day 30.2 degrees C; headache, pain in limbs, loss of appetite and general strength; on seventh day symptoms of acute rheumatism, painful swelling of both metatarsal joints; the disease progressed, many other joints becoming involved in succession; endocarditis was an added complication; by the fourth week both tympanic cavities healed but still showed slight thickening of the epithelial layers; hearing diminished to about half of normal acuteness; one and half years later death occurred from endocarditis.

Case of Right Otitis Media and Inflammatory Polyarthritis. Male, aged 18; slight angina April 1, 1896, four days later right otitis media; livid, moist, bulging drum membrane; hearing almost gone; bone conduction to right increased; rinne positive; temperature 38.6 degrees C; April 5, incision of drum membrane, draining bloody, serous secretion; April 9 no pain, no secretion, improved hearing; on eighth day incision healed, slight temperature, general health unimproved, continued constipation, anorexia, sudden rise in evening temperature 39.5 degrees C, severe pain in various body portions, particularly in neck and back; no proof of any other diseased organ established; on ninth day marked swelling of right knee joint; successively most other joints became involved, finally the cervical vertebral articulation also; in the course of inflammatory polyarthritis considerable pericardial exudate developed; later exudation developed in right pleural cavity; several attacks of cardiac weakness; irregular pulse up to 124 per minute; emaciation; gradual improvement after ninth week; complete recovery after a prolonged stay in the country; re-examination October 23, 1896; tendinous thickening of right drum membrane, handle of malleus and short process of the

malleus more prominent than in left ear, hearing in right ear 6 m. for whispered speech, in right ear 12 m.; November 6, 1896, recurrence of inflammatory polyarthritis in right shoulder joint and exudate in right pleural cavity, no preceding angina or otitis media; recovery on tenth day.

A Case of Acute Articular Rheumatism Complicating Acute Otitis Media. Joseph Popper, *Med. Rec.* 99, 270, Feb. 12, 1921.

Report of a case of acute articular rheumatism following acute purulent otitis media and considered interesting, both on account of its rarity and because of the fact that this condition may be so easily confused with the bacteremic condition following severe cases of middle ear disease usually complicated by mastoiditis or lateral sinus thrombosis.

The patient, male, nine years old, was admitted to the hospital complaining of discharge from the left ear and pain in the right ankle. The child had had all the usual diseases of childhood with good recovery. His tonsils and adenoids had been removed two years ago. The family history was irrelevant. Ten days before admission, he had been put to bed with a temperature of 102 degrees F., complaining of headache, running nose and slight, dry cough. Two days later pain developed in the left ear, from which there was a spontaneous discharge of pus that night. The fever ranged between 101 degrees and 104 degrees during the ten days prior to admission. The discharge from the ear became scanty, meanwhile, and on the eighth day of the illness, an otologist enlarged the opening in the eardrum without, however, increase of the discharge following. On the ninth day there was pain in the back, and on the tenth day pain in the right ankle. Physical examination showed that the head, eyes, right ear, mastoid, neck, heart, lungs and abdomen were normal. Spine and reflexes were normal, as were the urine and blood. There was a small amount of mucopus present in the left ear, but the drum was not bulging. Following admission, the patient experienced pain, tenderness and disability in almost all the large joints, and some of the small joints of the hands. By the sixteenth day the temperature, which had been ranging from 101 degrees in the morning to 104 degrees in the after-

noon, declined and reached normal on the nineteenth day. With this decline, the symptoms cleared up and the general condition improved remarkably. The patient had been treated expectantly until the blood cultures were reported negative. This fact, together with the absence of chills, led the author to believe the case one of acute articular rheumatism, as seen in childhood. Salicylates were given and in twenty-four hours symptoms were markedly relieved. The author suggests that acute articular rheumatism may be a symptom complex secondary to some focus of infection, rather than a definite pathologic entity.

X.

THE END RESULTS OF RADICAL OPERATIONS ON
THE ACCESSORY SINUSES.*

BY ROSS HALL SKILLERN,

PHILADELPHIA.

I don't know how often the question has been put to me, "Skillern, now as a man to man what is the ultimate condition of the patient after a radical on the frontal ethmoid?" or whatever sinus may be under discussion. As the frequency of this interrogation bespeaks its importance, I purpose with your indulgence, to base this dissertation upon the answer at least as far as my own personal experience is concerned. First of all, what is a radical operation on a sinus? I take it that when one speaks of a radical operation, one means an operation performed with the single thought in mind of an absolute relief from the symptoms with a more or less perfect cure regardless of the severity or extent of the surgical procedure. The last sentence expresses that which not infrequently takes place in that operation is oftentimes performed regardless of its extent or severity. That this expression has been repeated thus overly placing emphasis upon it is intentional and deservedly so, as did these not obtain, the question as to the ultimate results would never have been trite, but theoretical, and only of academic interest instead of representing the oft too trying reality which not infrequently arises in after months to plague those of us who are called upon to operate upon these cavities accessory to the nasal passages. When one considers the degrees in the severity of infection as well as the pathologic changes which have occurred, it is an extremely difficult task to approach this subject without entering into the details and finer minutiae. For the sake of clarity let us waive aside all so-called errors of judgment as to the advisability of the operation, overenthusiasm

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of the operator or last resort methods and assume that a radical operation was clearly indicated, but despite its timely application, the end results were not everything to be desired. What do we mean when we say the end results were not everything to be desired? As these differ markedly with the different sinuses it will be best to consider them from their separate and distinct standpoints.

FRONTAL SINUS.

It is presupposed in this sinus that an external operation through the brow with removal of one or more of the walls has been performed, what untoward sequelæ of a more or less permanent nature may follow?

1. Persistence of the pain.
2. Hemianesthesia of the brow and scalp.
3. Persistence of the discharge.
4. Neuralgia about the cicatrix.
5. Diplopia.
6. Epiphora.

I am purposely omitting the severer forms such as meningitis, blindness, fistula formation, etc., as our discourse is limited to the minor conditions which, however, are of sufficient annoyance to the patient as to prevent the operation from being termed a complete success. Patients are only too prone to forget the previous severity of their disease and dwell upon some present condition which would have been considered trivial had they suddenly been transformed from one to the other, but after all it is only human nature and there is not one of us here that would not feel similarly disposed were the personalities reversed and we were the patient instead of the physician. When a patient undergoes an operation he expects to be cured and all cured and should some slight trace of the old trouble linger or a new symptom appear, it is bound to be a source of dissatisfaction, and very real dissatisfaction at that, but if we could only make them realize that the surgical intervention was the means of saving or prolonging their lives or at least rescuing them from a state of chronic invalidism and they could also be made to understand that the chances of complete recovery are always inversely and not directly to the extent and severity of the

operation, the surgeon's task would be far easier than as at present constituted. To revert then to the untoward sequelæ let us for a moment consider the first one, ~~that~~ of persistence of the pain. After an external operation on the frontal sinus, if the pain persists, to be perfectly frank, either the operation was incompletely carried out and a focus of infection permitted to remain or the pain is due to some other sinus or, indeed, to some other condition which may be quite remote. I recall distinctly two patients which my operation failed to cure of their headaches, although both had chronic sinusitis; one subsequently was permanently relieved after his acidosis had been eliminated, while with the other the gynecologist succeeded wherein I had failed. So in these cases where pain is the principal complaint, while the external operation will, in the vast majority of instances, bring about complete relief, nevertheless the prognosis should not be entirely Utopian in its promises.

Hemianesthesia of the Brow and Scalp.—This condition always manifests itself immediately following the operation due to the severance of the supraorbital nerve close to its exit from the foramen and is always mentioned by the patient more, it is true, in the order of passing rather than an actual complaint. Fortunately the anesthesia is of temporary duration as in the course of a few weeks' regeneration of the nerves or a collateral anastomosis occurs with a return of full sensibility to the previously affected area. I have never seen a case where this has become permanent.

Persistence of the Discharge.—If I were asked to name the most frequent untoward sequelæ of an external radical on the frontal sinus I would unhesitatingly chose this one. In the natural course of events a purulent discharge always follows, which gradually assumes more and more a mucoid character, at the same time becoming less and less until in the course of weeks it ceases altogether. Unfortunately in a great many cases this discharge continues much longer than we care to see it despite appropriate treatments. If, in the quiet of our study we review our operation, small wonder will it appear that such a secretion makes its appearance, for it represents nature's attempt to throw off those portions of tissues which have been devitalized by our curettes and cutting for-

ceps. When we consider the bony cell walls, periosteum and adjacent mucosa which has been crunched, scraped and lacerated together with the ravages of the disease, much regeneration of tissue must occur before these parts again assume their earlier functioning activities. The persistence of this discharge will be directly to the extent of the surgical application and should this have embraced large and remote areas, just that much longer will it require before complete regeneration occurs, if indeed, it ever does. In any event, to use a classic phrase, a *locus minor resistencia* is established which may manifest itself with every exposure to cold and wet, or indeed, any cause which would be conducive to an acute coryza. However, in the advent of such an eventuality, all criticism must be instantly swept aside when comparison is made with the previous condition of the patient. Who of us would not gladly exchange the dangers and distress of a chronic suppurating frontal sinus with inadequate drainage for an intermittent mucoid discharge with no subjective symptoms, which moreover is gradually becoming less and less with the lapse of time? I am confident we would be unanimous on this point.

Neuralgia About the Cicatrix.—In my experience this is a relatively rare occurrence and when manifesting itself is due to the severed nerve ends becoming involved in the newly formed cicatricial tissue. Under the influence of massage it usually disappears in the course of time and I have never seen a case that required a subsequent resection for liberation of the enmeshed nerve filaments.

Diplopia.—Despite the assurance of Hajek, double vision is very apt to occur when the tendon of the superior oblique is elevated and its osseous support removed unless special measures are taken to prevent it. In many of my earlier cases permanent diplopia developed especially on looking downward, as, for example, descending a stairway, which required powerful lenses to correct the defective vision. For the past several years after the completion of the operation I have caught up the loosened tendon at its point of contact with the pulley and throwing a fine catgut ligature around it, tied it to the bridge of bone approximately in its original position. Since practicing this procedure, diplopia has manifested itself in

but one case, and curiously the muscle on the operated side appeared the stronger when examined by the ophthalmologist. This was due to my placing too much tension on the tendon while bringing it into position then tying it too tight. We have now profited by this experience, and while making it snug, are careful not to put it under any tension. At this point I would like to report a unique experience which happened in the early summer, a few months ago, with the first case on which I performed a Killian operation in 1908. This girl developed a marked diplopia which obliged her to constantly wear glasses. Fourteen years later the sinus again became infected; the condition refusing to respond to conservative methods, it necessitated a reopening of the affected area. After curetting away a small portion of diseased bone the tendon of the muscle was caught and tied as in the present method. I was particularly interested to learn what effect this would have on the long standing diplopia. You can imagine my feeling of satisfaction when on removing the bandages she said, "Why I no longer see double," and subsequent examination showed that she had fused binocular vision which has remained so ever since.

Epiphora.—When one considers that the lacrimal sac is elevated from its bed and the underlying bone resected, it is to be marveled that tearing does not invariably follow the radical frontal operation. As a matter of fact, it usually does if one takes the trouble to make a test, but fortunately it seems to be of but temporary duration and disappears shortly after the patient leaves the hospital. I have referred patients to the ophthalmologist immediately following the operation, who reported that it was difficult to force a passage for fluids through the membranous canal. On reexamination in three or four weeks, syringing succeeded with no difficulty whatever showing that nature had restored to the physiologic function of the canal as a drainage passage for the tears into the nose.

Now to return to our subject of end results, how many patients are troubled with these unpleasant sequelæ and how great is their degree of discomfort? I am not prepared to give definite statistics, but certainly less than 10 per cent have any of these one year after the operation. The most frequent

is the tendency toward catching cold with a discharge, but even this in time becomes less noticeable and for all I know ceases entirely. We do not perform the radical operation (except in a few instances such as threatened cerebral or orbital complications) until all conservative means have failed; but when indicated, it is one of the most satisfactory methods of relieving and ultimately curing a severe case of chronic frontal sinusitis that we have at our command.

MAXILLARY SINUS.

The radical operation on this sinus when properly performed is seldom followed by unpleasant after effects. Certain false steps, however, may be the cause of one of the following:

1. Anesthesia of the upper lip and teeth on the operated side.
2. Permanent fistula formation into the mouth.
3. Excessive dryness of the nose on the affected side.
4. Gradual return of the discharge after an apparent cure.

Anesthesia of the lip and upper teeth. The loss of sensibility of the lip due to cutting the inferior branch of the infra-orbital nerve frequently occurs but is only of temporary duration as full sensibility soon returns. Anesthesia of the teeth is a more serious matter and should never occur as it is due to faulty technic. Permanent anesthesia of the teeth means that the nerve has been injured or destroyed and usually presages the ultimate loss of the teeth except under very favorable circumstances in the hands of a first class dentist.

Permanent fistula formation into the mouth. This unfortunate sequela usually results from making the incision too far down on the gums, thus not having sufficient redundant tissue on closure of the wound. There is no necessity for this, and it can always be avoided provided, of course, that a previous fistula did not exist. As the permanent closure of these fistulas is almost a chapter in itself, time is insufficient to enter into that phase of the discussion.

Excessive dryness of the nose and affected side. A rare eventuality unless one is prodigal in removing the soft tissue of the inferior turbinate. I have rarely found it necessary to remove much of this structure and now our routine pro-

cedure is to remove only that portion of the lower edge anteriorly that obstructs free aeration of the sinus after the counter opening is made into the nose.

Gradual return of the discharge after an apparent cure. This disappointing result is usually due to insufficient removal of the diseased lining membrane of the sinus in which permanent pathologic changes had occurred. In my experience this omission takes place in the prelacrima recess, which can only be reached by a right angle curette. It is surprising while using this instrument to note the large amount of polypoid tissue that can be contained in such a comparatively small area. Another cause of failure is making too small a counter opening into the nose. I believe for the best results this opening should extend from the anterior end of the turbinate to about its middle and from its insertion well into the floor of the nose. It must be remembered that not only drainage, but aeration is required and I question very much whether the latter is not as important as the former in healing these old antral suppurations.

SPHENOID SINUS.

The important sequelæ which are connected with this cavity are:

1. Gradual closure of the opening before the suppuration has ceased.
2. Reinfection with intermittent suppuration.

Gradual narrowing with incomplete closure of the opening is observed in practically every case following operation on the sphenoid and is undoubtedly an effort of nature to restore the parts to their original condition. In most cases this is an advantage rather than a disadvantage if we presuppose that the sinus possesses some physiologic function.

Reinfection with intermittent suppuration is not an infrequent occurrence and usually succumbs readily after a slight enlargement of the ostium, which at this time is but a minor office procedure.

ETHMOID LABYRINTH.

The postoperative behavior of these cells depends upon so many factors that this phase of sinuology represents

today perhaps the most important in the entire category of paranasal affections. New methods of operating have sprung up here and there and been hailed as the last word, only to die away and fall into discard or become so modified as to entirely lose their original identity. This fact alone shows that of all the methods hitherto devised none have proven a *vade mecum* for all classes of cases. How many of us have seen cases of rather mild and decidedly bearable ethmoiditis made almost unbearable and well nigh hopeless by injudicious or incomplete operations. I know of no sinus condition where it is easier to advise operation or more difficult to extricate ourselves after this badly advised piece of surgery has been consummated than this very condition. How often has an anatomically perfect, though mildly infected labyrinth been transformed into a disorganized suppurating mass, which defies the best efforts of even a master to change it back to its former morphologic configuration with its normal physiologic activities. A great many more times even in our own practices, I dare say, than we would care to admit. Let us then consider more in detail the end results often following partial and complete ethmoidectomy with certain reasons pertaining thereto.

1. Continuance of the discharge.
2. Continuance of the pain.
3. Partial occlusion of the nostril.
4. Ocular symptoms which did not obtain previous to the operation.

Continuance of the Discharge.—Of all the most operative conditions one is called upon to treat this one I believe comprises more than all the rest combined. Accepting this statement at its face value, what reason can be attributed for the prevalence of the discharge following operation? In answering this question we can, as the Chinaman says, talk "goody goody" or tell the truth. If we choose the more difficult way we will say it was because we did not eradicate the disease at the time of operation and furthermore broke into healthy tissue which also became infected so that the end result was worse than the original condition. In analyzing such a case it was not altogether our fault for we proceeded according

to our best judgment, removing the cells as they appeared to be diseased. It is just here, however, that we made our error, both in judgment and in technic for one can differentiate by inspection through a nostril, diseased ethmoid tissue which might regenerate and that which imperatively must be removed. I think the preliminary resection of the middle turbinate followed by appropriate treatment and careful observation will very largely solve our ethmoidal problem.

Continuation of the Pain.—By this I mean headaches associated with an ethmoid infection continue both in their frequency and severity. It must be remembered that many other factors may enter here, and the hypothesis that our operation was incomplete and failed to remove the cause of the headaches may be without foundation as these pains might easily have some other genesis. In view of a more or less wide experience with this class of cases I have ceased to take these complaints as seriously as formerly, and now look for extrinsic causes (if I am convinced the ethmoid is not at fault) usually with success.

Partial occlusion of the nostril is only mentioned in passing and is due to carelessness in permitting synecia to form, thus interfering in a greater or lesser degree with the respiratory air current passing through the nostril.

Ocular symptoms which did not prevail previous to the operation. This is fortunately a very rare occurrence, even though only the thickness of a sheet of paper separates the orbital fat from the ethmoidal mucosa. I have frequently seen the conjunctiva become so engorged that it protruded between the lids following extensive operative measures on the ethmoid only to again recede and finally disappear without leaving any untoward effects.

Patients occasionally complain of a weakness of the eye, but this must be classed in the nature of a neurosis for the ophthalmologist always returned negative reports. I do not recall ever having seen a case of serious disturbance of vision following an intranasal operation, although such cases have occasionally been reported. In reviewing our ethmoidal work I am sure most of us will agree that it is best to make haste

slowly and not try to cure the patient in one full swoop. It is far wiser to remove the middle turbinate as a preliminary operation not only for the purpose of permitting better aeration and the furtherance of drainage, but what is even more important to allow comprehensive study of the labyrinth, which was an impossibility with this structure in situ. Finally let us remember that experience has taught us radical operations upon the accessory sinuses do not always spell radical cures.

XI.

TREATMENT OF OTITIS MEDIA WITH TUBERCULIN.

BY G. THOMSEN VON COLDITZ, M. D.,

CHICAGO.

We read the opinions of different men every day stating how long a suppurating ear should be discharging before we may pronounce it chronic and how long a chronic ear may discharge before operative procedure is the only hope of a cure for the patient. I do not wish to argue the question of when a case is acute or when it is chronic, that is of too little importance. But as far as putting a time limit on an old chronic case—whether it should be operated at once or given six weeks' treatment and then operated, if not cured—is wrong. If an ear which has been discharging from five to fifteen years will remain dry for one to two years following a course of treatments over a period of one to two years, we can claim to have cured the ear. The patient has been benefited far greater by not operating, saving him time and money, pain and discomfort, not to mention the danger connected with the operation and the prognosis of hearing.

It cannot be emphasized too strongly that we should not only make a diagnosis of what ails a patient but find the cause. The diseased organ frequently has bacteria present, but is also affected by toxins from bacteria in some other part of the body presumably healthy. The chief mistake made in these cases is the same as it always has been and always will be as long as cutting instruments are made, that the diseased tissue, whether the primary offending organ or not, is removed and the patient pronounced cured, without having removed the cause.

We read in text books and in medical journals that the removal of tonsils will cure most anything from a tubercular keratitis to a suppurative otitis media. The removal of tonsils and teeth is as popular today as the removal of ovaries was twenty years ago. The other day a doctor showed me a pair

of tonsils he had taken from a seven year old child. They were small and pinkish—as normal looking as any I have ever seen. On asking the indication for operating, he said that the child breathed through its mouth, had sore throat once in a while, poor appetite and that the mother had had peritonsillar abscess twice. The latter alone, I am sure, justified the operation.

The medical profession today is altogether too pessimistic regarding the use of tuberculin, which certainly is not warranted by the excellent results obtained. On asking different doctors about their experience with tuberculin, I was told by more than one that it was no good. However, at the same time they confessed they had never used it. Two reasons probably responsible for this skepticism in regard to tuberculin are: first, that men do not know which test is indicated in a given case, and second, that they do not understand how to use it therapeutically.

It is true that a large percentage of patients will react to tuberculin, even though they have not an active process. This is due to the extreme delicacy of the test, and also to the fact that most people have, at some time or other, had a tubercular infection. But the answer is—you must know how to interpret the reaction and how to differentiate the active from the latent infection.

When a patient comes to me complaining of a discharging ear, I first get a careful history. Very often I find that one or both parents have died from tuberculosis when the patient was a child and that their discharging ear dates back to that time. Following the regular physical examination of the ear, nose and throat, the pus is examined microscopically and a tuberculin test is made. X-rays are taken when practical. If the patient reacts positively to the tuberculin test, the chest is also examined.

First of all let us consider the various tuberculin tests, for, as previously mentioned, it is most important to know which one should be used in a given case. I will mention them in order as to their diagnostic value:

1. The Moro Test.—This, as you all know, is a salve made of equal parts of old tuberculin and anhydrous lanolin. A

small amount of the salve, about the size of a pea, is rubbed into the skin, which previously has been washed with soap and water. I usually choose the upper part of the abdomen. When positive, within twelve to twenty-four hours there is a reaction at the site of application—a redness of the skin with papule formation. The intensity of the reaction varies in different cases, often not starting until the third or fourth day and lasting, usually, from five to ten days. Frequently, especially in so-called “scrofulous” children, the reaction is very severe accompanied with considerable itching. The advantage of this test lies in its easy application, however, it should not be used in children over ten.

2. The von Pirquet Test.—This, like the Moro test, is of value only in children. The technic consists in scarifying the skin, choosing the inside of the upper arm, which has been made sterile, in two places about an inch to two inches apart. Care should be taken so as not to draw blood. A drop of old tuberculin is now placed on one of the scarified areas, the other being used for control. If positive, an indurated area appears around the spot where the tuberculin has been applied. It is the tuberculin coming in contact with the epithelium of the skin that causes the reaction. The reaction varies in degree according to the susceptibility of the patient and the amount of tubercular infection present. We may have a local reaction at the same time in an eye, for instance, with a tubercular iritis present.

3. The Conjunctival Test.—This consists of the instillation of a drop of one per cent Koch’s old tuberculin solution into the conjunctival sac. The eye is allowed to close for a minute and then the lower lid held down for a minute. Within eight to twenty-four hours we get a reaction which may only consist in a redness of the lower lid, but may also be most severe, causing inflammation of the uveal tract, conjunctiva bulbi, and edema of the lids. The reaction may be so severe as to injure the eye, and, therefore, should not be used.

4. The Intracutaneous Test.—This test is very reliable and may be used in children as well as in adults. Besides being of a positive diagnostic value, it has the advantage over the subcutaneous test, which is considered by many as the most valuable one, in that it may be used in ambulatory cases. It

has the advantage over the other tests mentioned previously in that we know the exact amount of tuberculin used, which amount may be increased in consecutive tests.

The technic is as follows: A fine needle is best adapted for this purpose, with a regular tuberculin syringe. A fresh solution of old tuberculin, the strength of which is one milligram to one-tenth of a cubic centimeter of sterile water, is drawn up into the syringe, which has been sterilized. The forearm is now made sterile and the needle introduced into the stretched skin, running the same parallel for about a quarter of an inch. Then we inject one-tenth of a cubic centimeter into the skin in such a manner that a white bleb is formed, showing it to be intracutaneous. The needle is then carefully withdrawn. When positive, a slight reaction is seen within six hours and a marked reaction within twenty-four hours, a zone having formed around the injection, the size of which indicates the amount of reaction. The halo may reach the size of a silver dollar, but the average size is about that of a nickel or a quarter. The reaction is most pronounced at the end of the second day, and on the third it begins to diminish. Reaction may be present for several weeks, the periphery being the first to disappear. If no reaction has occurred in three days, we inject in similar manner three milligrams, and three days later, if negative, five milligrams. Some men go as high as ten milligrams. Personally, I have never given over five milligrams in a suspected case.

5. The Subcutaneous Test.—This test is without a doubt the most valuable one we possess, although its reaction is the most severe and is, therefore, contraindicated in certain cases, in which instance we should use the intracutaneous test. One great advantage of this test is that in a positive case we not only get a local reaction but also a focal reaction which is most valuable. The procedure for this test is as follows: The patient should be kept as quiet as possible, not necessarily in bed, for two days prior to the injection of tuberculin, in order to get his normal temperature and the range of same. The temperature should be taken every two hours and a careful record kept. On the third day the tuberculin is injected, preferably in the morning so as to be able to see the reaction within six hours. The patient is kept at home but not neces-

sarily in bed. The writer favors Koch's old tuberculin. The injection may be given into the arm, leg or abdomen or almost any other practical place. Usually the upper arm is found to be the most satisfactory. The regular Parke-Davis tubercular glass syringe with a platinum needle is the most practical and is easily kept sterile. According to Koch, three injections at intervals of three days are given, the first injection of 1 mg., the second of 5 mg., and the third of 10 mg. Personally I consider this dosage a little high and give 1 mg. for the first, 3 mg. for the second and 5 mg. for the third dose at three day intervals. Naturally these injections are given with all aseptic precautions. The patient is instructed to keep quiet and not scratch the arm or put on cold compresses to relieve the reaction. The temperature is taken regularly again and compared with the temperature before the injecting. In positive cases we usually get a reaction within ten hours, but it may start within six. The temperature will vary from 100 to 102 degrees F. and over when the test is positive. The first injection may give a slight reaction and the second a very severe one; in that case a third injection is not indicated.

Inasmuch as the temperature plays a most important part in this test, it would be appropriate to say a few words about taking the temperature. Most thermometers are marked either one-half or one minute and are usually only given that amount of time for taking the temperature. The average doctor does not even seem to take into consideration whether the patient has just come in from the cold or just had a glass of ice water to drink, not to mention the nurse who seems to think that speed is essential in taking temperature. Rarely do I find a patient whose temperature will go to normal in one minute with a half minute thermometer. To be sure of an accurate temperature, a thermometer should be left in the patient's mouth for five minutes and then read and put back in the patient's mouth for one minute. If the temperature remains the same, it is correct; if not, repeat until it does not rise. I have left the thermometer in the patient's mouth for ten minutes before getting the maximum temperature. The old fashioned method of taking the temperature by axilla, I believe has been entirely discarded. The rectal

temperature when possible should always be used by preference as this is the most dependable and will, at times, show elevations of temperature which will not be shown by mouth. This is particularly true in mouth breathers.

The writer wishes to state here that he has had a number of cases of old chronic suppurating otitis media, some of five to fifteen years' standing, that have gone from one doctor to another, have had many treatments and were then told that unless they were operated upon they would either not be cured or would die from meningitis. These same cases, after careful examination gave a ++ and +++ tuberculin reaction, received local treatments combined with graduated tuberculin injections and were absolutely cured within six months to a year and a half. In some cases the hearing was restored to normal after the perforation in the tympanum had been closed with subsequent treatments. At the same time the patient's general health was markedly improved.

Of all adults treated only one showed tubercle bacilli in the pus, together with other bacteria. This patient, when I first saw him, besides having a suppurative otitis media, was in the last stage of pulmonary tuberculosis with involvement of the larynx. He claimed his ears had been discharging for years. The patient died within about a month after the first time I saw him from general tuberculosis. His treatments were only general. As expected, in this case there was no reaction following the tuberculin test.

The writer has had a number of cases other than ear that he would like to just touch upon in connection with this tubercular treatment to show how commonly tuberculosis is overlooked and often diagnosed as syphilis.

One patient, with a large perforated septum was pronounced by an examining specialist as syphilitic. I made a tuberculin test and it reacted ++. After tuberculin treatments the nose cleared up from crusts and discharge, and the patient was comfortable. She considered herself cured.

Another patient was treated for syphilitic vocal cords which were almost gone. He could not speak above a whisper. The tuberculin test, intracutaneous, showed +++ reaction. After 20 B. E. tuberculin injections the cords appeared normal

and the patient had a strong voice again so he could do public speaking.

A third patient was treated for syphilitic keratitis by an eye specialist. After 20 B. E. tuberculin injections the eye was well. The cornea which had been so opaque that the iris could not be seen was clear and the vision good.

I am aware of the fact that many doctors claim the same results that are obtained with tuberculin can be obtained with yeast and other proteins, but personally I am convinced that this is not correct, basing my statement on the results I have obtained in various cases. The statement that all patients over a certain age respond to a tuberculin test is also contrary to my findings.

I do not mean to claim to be able to cure all suppurative otitis media cases, but I wish to call the attention to the fact that many cases are neglected that could be cured with tuberculin.

The following cases came to me for treatment of chronic suppurative otitis media. I am only considering those which reacted positive to a tuberculin test and that were treated with tuberculin in addition to local treatment, in which cases I attribute the good results to the tuberculin used.

REPORT OF CASES.

1. Ruth U., age 20, single, American, Swedish parents. Family history negative.

Personal History.—Patient had diseases of childhood. For past three years patient has been getting boils on arms and her back, new ones starting every few weeks to a month. Some boils contained as much as two drams of pus. Had several courses of autogenous vaccin, with no results. Was then put on diet with yeast, no results. Then one year ago patient's right ear started to discharge.

Examination.—Patient well developed, well nourished. Chest $30\frac{1}{2}$ inches, $1\frac{3}{4}$ inch expansion and negative. Temperature 99.4, pulse 82. Number of boils on arms and one very large one on back. Right ear: Mastoids normal. Tympanum, small central perforation with slight discharge. Pus shows staphylococci. Tuberculin test was made; 1/10 cc. representing one milligram of old tuberculin was injected intra-

cutaneously. In twenty-four hours there was a very marked reaction, the halo reaching the size of a silver dollar and lasting for over two weeks. This was what I term a +++ reaction.

Treatment.—Patient was given B. E. tuberculin injections, one every five days, receiving thirty injections in all. After about fifteen injections, the boils disappeared and the ear was dry. There has been no recurrence. Patient gained about ten pounds in weight. There was considerable reaction following each injection.

2. Miss A. R., age 36, American, German parents.

Family History.—Father died at 38 of tuberculosis, sick three years. Mother died at 44 of tuberculosis, sick six months. One sister living and well, and one brother has ear trouble.

Personal History.—Patient had whooping cough, diphtheria, chickenpox, measles and mumps as child. When 10 years old, right ear started to discharge, getting more profuse each year. At the age of 16 started headaches over frontal sinuses, which she has had the greater part of the time. For the past ten years patient has had a slight cough, raises a great deal of mucus mixed with black particles. Three years ago pain developed in the left knee. She was unable to straighten out her leg at night on account of pain. X-ray pictures of the knee were negative. In spring of 1920 left ear started to discharge. Patient perspires slightly at night.

Examination.—General condition good. Height 5 feet 2 inches, weight 116 pounds. Temperature 99, pulse 80. Chest negative. No enlarged glands. Mastoids: External inspection negative. Auditory canals large. Right tympanum only small margin left. Left tympanum medium sized perforation. No reflex. Retraction of malleolus. Both eustachian tubes free. Right ear discharge very profuse, left ear small amount. Hearing almost normal. Pus microscopic: Diphtheria and diphtheroid bacilli. X-ray showed no cells in mastoids and cloudy frontal sinuses. Tuberculin intracutaneous test gave a +++ reaction.

Treatment.—Started April, 1920. Auditory canal closed with cotton on applicator. Ears inflated with iodine, menthol and camphor and autogenous vaccinia given over a period of

two months, no results. In October of the same year treatment continued. This time B. E. tuberculin used. Treatments again extended over two months. Discharge decreased, patient's cough diminished and knee felt better. The following June treatments were continued for one month. Left ear stopped discharging. Knee was entirely free from pain; no more cough, and headache gone. Slight discharge in right ear. January, 1922, patient returned for treatments with only very slight discharge in right ear. Left ear dry. No headache, no cough, no expectoration. Knee normal. There was reaction after every injection.

3. Miss E. A., aged 20 years, American born.

Family History.—Parents both dead. Patient believes mother died of tuberculosis. No brothers or sisters.

Personal History.—Patient had diseases of childhood. Coughs a little, especially in morning. Has night sweats once in a while. Discharge from both ears since childhood. Has had treatments at different times. Feels tired all the time. Great deal of headache.

Examination.—Tall and poorly nourished. Anemic. Enlarged superficial cervical glands. Tonsils No. 11. Temperature 99.3 degrees F. Eyes: Slight conjunctivitis. Mastoid prominent, not tender; large perforations. Rinné test negative. Eustachian tube free. Hearing: Watch R. E. $\frac{1}{2}$ ft., L. E. 1 ft.

Treatment.—Ears kept clean and packed with dry gauze. T. R. tuberculin injections every five days. At end of ten months' treatment, both ears dry. Patient left the city after that and went to Michigan. About one year later I heard from a friend of hers that she was married and in good health.

This patient had a Moro test made and reacted strongly to the same. This was in 1915, when I was not using the intracutaneous test, to which I now give preference.

4. J. M. H., age 33 years, male, married; born in Norway. Family history negative.

Personal History.—Patient always well, except discharge from right ear for the past seventeen years. Has had treatments without results.

Examination.—September 8, 1915. Patient well developed. Chest negative. Left ear: Normal in appearance. Hearing normal. Right ear: Mastoid normal. Auditory canal negative. Tympanum, large central perforation. Thin purulent discharge containing staphylococci and streptococci. Hearing: Watch at $\frac{1}{2}$ foot. Moro test negative.

Treatments.—Ten injections of stock vaccin given in connection with local treatments with no improvement.

After a period of about one month, T. R. tuberculin injections were given, one injection every five days and local treatments every three days. A slight reaction followed each injection. The ear would stop discharging for a few months, then when the treatments had been discontinued for a while the ear would start discharging again. At the end of eight months the ear remained dry. After that local treatments were given to close the perforation in the tympanum, which was accomplished in three months. Hearing two years later was watch at 4 feet. The ear had remained dry.

5. M. P., aged 15 years, female, American born, Italian parents.

Family History.—Father killed by blackhand, mother well. Five sisters and five brothers living and well. One sister died from infected axillary gland.

Personal History.—When patient was two years old the right ear started to discharge. One year later mastoid operation performed by the writer. Some time later the left ear started to discharge. The patient complains of a great deal of headache. Always complains of not feeling well and being tired. The mother has remarried and the patient gets no attention at home.

Examination.—Chest very large, overdeveloped breasts, otherwise negative. Enlarged superficial cervical glands. Ears: No tenderness over mastoids. Very large tympanic perforations. Profuse discharge from both ears showing staphylococci and pneumococci. Hearing: R. E. watch 1 foot. L. E. watch $\frac{1}{2}$ foot. Rinné test R. E. —, L. E. —. Temperature 99.3 degrees F. Moro test negative; 1/10 tuberculin intracutaneous gave little reaction; 3/10 tuberculin injection gave marked reaction.

Treatment.—Ears cleaned with cotton. Patient told to keep cotton in ear, but comes to office without it every time and says, "I forgot." No other treatment given except tuberculin injections. The patient has now been treated for $1\frac{1}{2}$ years. After about one year's treatment, which had been interrupted during the summer, the right ear has remained dry for six months and the left ear has only a very slight discharge.

This patient's results have been particularly gratifying, inasmuch as she has been so irregular in coming for treatment, and has taken no care of herself at home to assist in a cure. Her physical condition in general has also improved during these treatments.

CONCLUSIONS.

1. A patient with a chronic suppurating ear should always be tested for tuberculosis.
2. When a patient reacts positive to the proper tuberculin test, he should be treated with tuberculin, even though other bacteria are found present in the ear discharge.
3. A patient reacting positive to a tuberculin test should be impressed with the fact that his prognosis is good, providing he takes his treatments regularly.
4. A mastoid operation should be done only as a last resort for cure.

XII.

THE PRACTICAL DIAGNOSTIC VALUE OF TESTS OF THE VESTIBULAR MECHANISM.

BY FRANK L. DENNIS, M. D.,

COLORADO SPRINGS.

In view of the increasing use of tests of the vestibular apparatus and the numerous discussions of the subject appearing in the literature, is it not time to take stock of our knowledge and review some of the reports made?

Examination of the vestibular mechanism is already of tremendous usefulness in diagnosis and is destined to be of still further service as we add knowledge to our store from the labors of keen workers in this field. I need only mention among others, the recent contributions of Ingham and Jones, Fisher, Bárány, Neumann and Buys. A host of questions arise in the minds of those doing this work:

What effect does epilepsy have on the vestibular mechanism?

Is there a toxemia in tuberculosis that causes definite reactions?

In what manner does encephalitis affect the responses, and why?

Is there an orientation center in the frontal lobe, as suggested by Lasagna, and what relation has it to the pathways from the labyrinth?

Why does one occasionally see nystagmus in the early stages of pneumonia and erysipelas?

When these questions and others are answered, the diagnostic value of these examinations is bound to be enhanced.

As is inevitable when any new procedure is instituted, variations in technic creep in, some of the claims made in the beginning are not substantiated, others are strengthened, and, piece by piece, the structure of fact is built up. It is the purpose of this paper to call attention to some of these details and to record some observations which, it is hoped, will contribute to the sum total.

In the first place, I desire to emphasize the need for a uniform technic in conducting the examinations and a uniform nomenclature in recording the findings. One observer douches with water at 68 F., another at 65 or 55 F.; in one case, rotation is carried on at the standard rate of ten turns in twenty seconds for the production of nystagmus, while in another the rate may be greater or less, and so on. Such variations may or may not be important, but surely, in establishing the value of any procedure where so many points are still undetermined, uniformity of technic is essential.

In some reports, many facts are not stated; such as, for instance, the exact state of the hearing; the number of past pointings after rotation; measurement of vertigo after stimulation; whether there was nausea and vomiting following the test; or whether the complete test was made at one sitting, and, if not, the number of seances required to complete it.

Care is important. A faulty position of the head in turning or douching may cause apparent perversion or inversion of the nystagmus, as pointed out by Jones and Fisher.

Let us follow closely the standard technic of ten turns in twenty seconds for the production of nystagmus, ten turns in ten seconds for the measurement of vertigo and the eliciting of past pointing, and douching with water of exactly 68 F. for the caloric test.

In this connection I refer to a most excellent paper by Vail¹ on the results of the vestibular tests in ten cases of acusticus tumors. It is worthy of note that the last three cases of this series exhibit the typical "angle lesion syndrome," because they were so examined as to bring this out, while the earlier cases were not so examined and do not show it. The one additional thing which would have completed the picture is a caloric test of the horizontal canals of both sides. Undoubtedly, all the available data were reported by Dr. Vail, but the point is that, in all probability, when the earlier cases were examined, the significance of all the factors in the angle lesion syndrome was not appreciated. In but few of the cases was a measurement made of the vertigo response, and in the caloric tests the temperature of the water varied between 50 and 68 F. According to Jones and Fisher, angle lesions produce the most typical vestibular responses of all intracranial

onds for turning in the two directions, respectively. One hundred and eighty of these men were rotated with the head 60 degrees backward, thus stimulating the anterior vertical canals. The findings were: Turning to the right, the nystagmus time averaged 15.56 seconds; turning to the left, nystagmus time averaged 16.19 seconds.

The posterior verticals were tested in 300 men, by rotating them with the head on the right shoulder. The average nystagmus time after turning to the right was 16.85 seconds; after turning to the left, 15.60 seconds. It is, of course, understood that when we speak of stimulating the posterior or anterior verticals, this is true only in a certain sense, and that when one vertical canal is stimulated, the other also participates.

These experiments prove that the average nystagmus time after turning is decidedly less from the vertical canals than from the horizontals. This fact may have some relation to the fact that the verticals are more vulnerable. Owing to this greater vulnerability of the vertical canals and their pathways, much care should be exercised in evaluating the importance of failure of their responses.

Anomalies of past pointing after stimulation are also frequently encountered. This may be due to the fact that past pointing is a voluntary act. It is a manifestation of vertigo, and vertigo, being subjective, can be controlled in its manifestations by education and practice. My own experience leads me to place less reliance on aberrations of past pointing than on any of the other findings from vestibular tests, and to disregard them unless they are corroborated by other findings indicative of central lesion.

Discussion and data on the foregoing two points are much needed to make clearer their significance. Much good judgment is needed in weighing all the evidence adduced in these tests, and in all cases it should be studied in connection with the findings from all other examinations.

One of the difficult things to interpret is the changing pictures which we get on reexamining certain cases. I do not refer to the changes which take place in a case in which a tumor is growing in a certain direction, and thereby involving different pathways and thus adding to the signs. I refer

to those cases in which there is a return of the responses which were previously lacking. Ingham and Jones, in their paper presented recently before the American Otological Society, describe such a case. I reported a similar one at the meeting of the Midwestern Section of the American Laryngological, Rhinological and Otological Society this year, and Case 8 of the series reported in this paper exemplifies it. These experiences emphasize the need for repeated examinations and careful consideration before formulating conclusions.

In the following reports, cases have been purposely selected, with one exception (Case 10), in which the diagnosis has not been confirmed by operation or necropsy. Many of them present difficulties in diagnosis. They are divided into three groups: Epilepsies, toxemias (including tuberculosis), and intracranial lesions. The group of syphilitic toxemias is omitted. All have been examined with the routine technic outlined above, except when variations are noted.

REPORT OF CASES. FIRST GROUP, EPILEPSY.

Case 1.—Mrs. L. V. S., aged 59, examined May 10, 1921, gave a history of measles and whooping cough in early childhood, abscess in right ear at 7 years, and diphtheria at 12 years. She had been a little deaf since having the abscess, growing worse for the last eight years.

For ten years she had been having nervous attacks every three or four weeks; the eyes turned in; the right arm jerked and twisted inward, sometimes the head twisted and she became unconscious. Immediately preceding the attacks she had a sensation as if something flashed by her head from right to left. She did not bite the tongue or suffer nausea during attacks. She thought she was dizzy at times. She had no headaches. The attacks, which lasted from three to five minutes, were diagnosed as epilepsy by a neurologist.

Examination of the nose and throat was negative. Examination of the ears revealed that both drum membranes were intact and normal in appearance. The hearing was:

	0	1"	poor	ac < bc > n	6"
C ⁶⁴	—	C	—	C ⁴ —————	W. V. —
	4"	10"	good	ac > bc = n	8'

Weber to right from left mastoid.

Vestibular examination (Fig. 1) revealed as notable points, slightly exaggerated nystagmus and correct past pointing from turning with head 30 degrees forward, but with diminished vertigo.

On douching of the right ear with the head 30 degrees forward, there was no nystagmus but correct past pointing. On putting the head back, there was good reaction from the horizontal canal in nystagmus and past pointing.

On douching the left ear, with the head 30 degrees forward, there was a very poor nystagmus, with correct past pointing elicited. On putting the head back, there was an excellent response. The entire examination was completed at one sitting. There was no nausea, pallor or sweat.

Two days later, the patient was turned with the head back 60 degrees and forward 120 degrees. In the former position a very poor nystagmus of short duration was elicited on turning to the right but none on turning to the left. In the latter position the falling reaction was correct. Douching of the left ear gave no nystagmus from the verticals, but a correct response from the horizontal canal.

Case 2.—Mrs. E. R. W., aged 39, who was examined April 20, 1921, gave a history of three family deaths (father, brother and sister) resulting from tuberculosis. The patient had had pulmonary tuberculosis ten years ago, but the case was now arrested. She had had the usual childhood diseases, and had pneumonia in early childhood. She had typhoid at 19. On getting up one night, one year ago, she was very dizzy and lost her sense of direction. She could not stand up the next day on account of vertigo, but she gradually grew better during the next four or five days. She had a second attack one month later, lasting ten days. The last attack occurred one week ago. On sitting up in bed to pull up the covers, she grew very dizzy and vomited, and she could not lie on either side. This lasted until 4 a. m., when she grew better. By noon the next day she was free from vertigo. After lunch she lay down and again became dizzy. On the following day the menses appeared and vertigo ceased. During this attack there was a slight horizontal nystagmus to the left on looking to the left when she sat up, and on lying down there was a

rotary nystagmus to the right on looking to the right. There was a history of epileptic attacks for the last seven years, occurring at intervals of from five to twelve months.

The patient had been under the care of two competent neurologists, who reported: Blood and spinal fluid Wassermann reaction negative; eye grounds negative; fields normal; reflexes normal; all cranial nerves normal; no convulsions in babyhood but one brother had them and mother and one sister are nervous wrecks.

Examination revealed: The nose, throat, teeth and ears were negative except that there were stumps of tonsils remaining. The hearing was:

$$\begin{array}{rcccl} 3'' & 6'' & \text{good ac} > \text{bc} < \text{n} & .7 & 20' + \\ C^{64} - C & - C^4 & \text{Galton} & - \text{W. V.} & \\ 2'' & 6'' & \text{good ac} > \text{bc} < \text{n} & .7 & 20' + \end{array}$$

Weber to left.

Vestibular examination (Fig. 2) revealed: No spontaneous nystagmus or past pointing; negative Romberg sign. The notable findings are: Subnormal nystagmus from horizontal canals, very much diminished vertigo; no nystagmus and only slight vertigo from right vertical canals; poor nystagmus and marked vertigo from the left verticals, correct past pointing from all canals; nausea after completion of caloric test. The examination was conducted in two sittings, with a five-day interval.

Case 3.—H. K., aged 16, second child, who was examined Sept. 8, 1921, and whose family history was negative, was a blue baby. The tonsils had been removed nine years previously. He had had chickenpox, whooping cough and influenza, and his stomach had always been easily upset. He was otherwise healthy. He had had two attacks of epilepsy, the first one nine weeks previously, the attacks following over-eating. There was no history of vertigo, deafness or tinnitus, though the patient said that the ears had felt stuffy for two days. He had a slight cold.

On examination, there were no neurologic findings; the heart was slightly irregular; blood pressure: systolic, 108; diastolic, 50. Both inguinal and right epitrochlear glands were palpable. There was considerable adenoid tissue and stumps

of tonsils remaining. The right membrana tympani was congested, the left normal. The hearing was:

$$\begin{array}{rcccl} 3'' & 12'' & \text{good} & ac < bc > n \\ C^{64} - C - C^4 & & & & \\ 4'' & 12'' & \text{good} & ac > bc = n \end{array}$$

Weber to right.

Vestibular examination (Fig. 3) revealed: No spontaneous nystagmus, past pointing to left with left hand. The entire test was made at one sitting.

On stimulation, there was subnormal nystagmus on turning to the right, markedly diminished vertigo, erratic past pointing with the left hand; no nystagmus from the right verticals and a very poor response from the left verticals; good nystagmus from both horizontals; nausea; sweat, pallor.

The findings common to all three of these cases are: Good hearing (except the first, in which the deafness is of the obstructive type), poor vertigo responses, interference with the nystagmus responses from the verticals, and correct past pointing. The findings are reported as a matter of record, and no attempt is made to draw deductions from them. So far as I am aware, no vestibular findings have previously been reported in epileptic cases.³

SECOND GROUP: TOXEMIA.

Case 4.—Mrs. McC., aged 47, whose chief complaint was vertigo, gave the following family history: The father died at 63, of cancer; the mother at 69, of pneumonia; two brothers are living and in poor health. She had earache, measles, mumps and malaria in childhood. She had been operated on for pelvic trouble fifteen years previously. She had chronic interstitial nephritis. The blood pressure was 190, systolic. Eighteen years previously she received a blow on the root of the nose, which affected the left eye, causing a blind spot. She had had dizzy spells before the pelvic operation.

She had suffered from the present illness for the last six or eight months. She had been dizzy at times, usually worse in the mornings. The left foot turned out too much, so that she struck her heels against each other. She could not walk straight. Occasionally she had tinnitus. She was subject to headaches, which are sometimes severe, and during the head-

ache had pain in the left ear. She was generally well otherwise except that her head did not "feel right." The hearing was:

4"	10"	good	20' +	ac > bc = n
C ⁶⁴ — C — C ⁴			W. V.	
4"	6"	good	20' +	ac > bc = n

Weber to left.

Vestibular examination, in two sittings (Fig. 4) revealed: No spontaneous nystagmus nor past pointing; Romberg sign; tendency to fall to left, not influenced by position of head. On turning, there was slightly hyperactive nystagmus and past pointing with subnormal vertigo.

The caloric test revealed: No nystagmus from right verticals, nor past pointing with right hand, rather poor nystagmus from right horizontal and right hand does not past point; poor nystagmus from left verticals and good from horizontal; no past pointing; little subjective vertigo but some nausea. Patient vomited after reaching home.

One week later the ears were douched again and an entirely different picture was shown. Responses were prompt and good from verticals and horizontal of the right side, although the left hand did not past point. The nystagmus from the left verticals was delayed, and there was no past pointing. A report was made that the neurotologic tests pointed to toxemia. Under appropriate treatment of the kidney condition the vertigo disappeared.

One is puzzled to explain the change from a poor to a good reaction from the caloric test within such a short period. This case also illustrates the importance of repeated examinations.

Four patients having tuberculosis have been subjected to the neurotologic tests, all of whom complained of vertigo. All showed abnormal findings on vestibular stimulation. Two of these had middle ear tuberculosis, bilateral in one, on whom a radical mastoid operation had been done on one side. The other two had practically normal hearing. The suspicion was entertained that toxemia from a tuberculous infection may be a possibility. The record of one follows:

Case 5.—A. P. M., aged 47, came to Colorado on account of pulmonary tuberculosis, one year previously. He had little

trouble. The first attack of dizziness occurred more than a year previously, and immediately followed roentgen ray treatment of a tooth which was extracted soon afterward. A severe attack of vertigo six months before examination, with no vomiting. Another attack occurred two weeks before examination. The patient had a tendency to fall to left and backward, and objects turned to the right.

He has had pneumonia, mumps and stomach and bowel trouble. The tonsils have been removed. There was a history of a discharging ear several years previously.

Examination revealed: The nose and throat were negative. The ear drum membranes were normal; the hearing was good. Vestibular examination was made in two sittings (Fig. 5). There was no spontaneous nystagmus; the Romberg was negative; sometimes the patient past pointed to one or the other side, and sometimes touched. There were slightly subnormal nystagmus and vertigo after turning; no responses in nystagmus or vertigo from verticals of either side. Past pointing was erratic. From the horizontals, there were good nystagmus and vertigo. Douching was repeated four days later with the same results.

The significant points are lack of responses from verticals, with good responses from the horizontals and good hearing.

THIRD GROUP: INTRACRANIAL LESIONS.

Case 6.—Mrs. E. T. P., aged 48, examined May 20, 1921, complained of vertigo and nausea. She had always been well except for an operation for gallstones and diseased appendix four years previously. The first attack of vertigo occurred fourteen years previously, and next one four years previously. The last attack, occurring six weeks previously, was followed immediately by tonsillitis. The patient vomited the first day and was better the next, but had been more or less dizzy ever since. There was no headache. She had a "gripping" feeling in the back or top of the head, like pressure. She had been deaf in the right ear for eleven years. There was tinnitus at times.

Examination by her physician was negative. The spinal and blood Wassermann reactions were negative. Examination of the nose and throat was negative, except for diseased

tonsils. Examination of the ears revealed that both membrana tympani were intact; the right tube was narrow. The hearing was:

	4"	8"	poor	4.0	6"
C ⁶⁴	—	C	—	C ⁴	—
	4"	8"	fair	1.1	36"

Weber to left. The fork on the right mastoid was heard only in the left or better hearing ear.

The vestibular examination (Fig. 6) was conducted in two stages.

The noteworthy findings were: No spontaneous nystagmus; Romberg sign positive; falls backward with all positions of the head. After stimulation, there were subnormal nystagmus and vertigo; no past pointing with left hand after turning to left. On douching, there was no nystagmus, vertigo or past pointing, from right vertical canals, and barely a trace from verticals of left side. There was correct nystagmus from the right horizontal, and a good but perverted nystagmus from left horizontal. Ten days later the douching was repeated. At this time there was no reaction from the verticals and a questionable one from the horizontal of the right ear. Douching of the left ear showed no change from previous examination.

Eleven days afterward the ears were douched with the head 60 degrees backward. In the right ear, after five minutes' douching, there were no responses from verticals or horizontals. In the left ear an oblique nystagmus upward and to the right, of small amplitude, appeared after one minute and forty-five seconds, which became rotary on putting head upright. The patient past pointed only with the right hand to left before putting head upright.

She was referred to an oculist, who reported that there was no intraocular pathologic condition, but that the patient had 4 degrees of exophoria, and the glasses she was wearing were not properly corrected. Correct glasses relieved her of vertigo attacks.

Four months later another vestibular examination (Fig. 7) was made. The differences between the findings in this examination and those of previous ones are: A slight increase in

the nystagmus and vertigo time after turning; no past pointing with either hand after turning to the left, while at previous examinations the right hand past pointed to the left.

On douching, there was now a poor and delayed nystagmus from verticals of both sides, whereas previously these had failed to respond, and there was a good nystagmus from the right horizontal. The nystagmus from the left horizontal was still perverted. The entire examination was made at one sitting, without any subjective disturbance, except slight vertigo. The patient said that she was free from vertiginous attacks and felt well.

A report was made after the two earlier examinations that the ear tests pointed to a cerebellar lesion on the right side; and, in spite of the subjective improvement, I am still inclined to think there is intracranial trouble. The case illustrates the difficulties one meets in interpretation owing to the changing picture. The question of toxemia (possibly from a focus in the tonsils) must be considered, but it is difficult to reconcile the perverted nystagmus with this hypothesis.

Case 7.—Diagnosis by the neurologist: Encephalitis. Miss M. G., aged 18 years, on Oct. 18, 1921, complained of numbness on the left side of the face. This proved on examination to be limited to the chin area. Three days later, the patient became very dizzy, the attack lasting three days. One week later another dizzy attack appeared, accompanied by nausea and vomiting, staggering and falling to the left and tinnitus.

Examination revealed that the spinal fluid and blood Wassermann reactions were negative. Nose, throat and ears were normal; the hearing was normal. There were no pupillary abnormalities; eye grounds were negative. *Adiadokokinesis* of the left hand and marked incoordination of left hand were noted.

Vestibular examination two days after attack of vertigo began (Fig. 8) revealed: Spontaneous horizontal nystagmus to right and left, and vertical and rotary nystagmus on looking upward; past pointing 4 inches (10 cm.) with the left hand; Romberg sign positive.

On douching, there was no nystagmus from verticals of either ear; there was correct past pointing after stimulation

of the right ear, but faulty after stimulation of the left ear. There was good nystagmus from the horizontals, with a tendency to conjugate deviation.

On turning to the right, there were subnormal nystagmus and vertigo; on turning to the left, the nystagmus was exaggerated and vertigo was subnormal.

It was suggested that the vestibular examination pointed to a lesion near the pons on the left. The vertigo improved within a few days, although the numbness of the face extended up to the hair margin. Within ten days all symptoms improved and eventually disappeared.

Another examination, one month later (Fig. 9) revealed that all spontaneous signs had disappeared except that the left hand past pointed 2 inches (5 cm.) to the right. Turning revealed normal nystagmus and vertigo responses. The verticals of both sides still failed to yield nystagmus on douching. The horizontals reacted with normal nystagmus. The past pointing was still erratic after stimulation of the left ear. In view of the rapid improvement, it seemed probable that a later examination would reveal normal findings.

The entire examination was made at one time, and after completion of the caloric test the patient became nauseated and vomited.

Case 8.—V. M., aged 14 years, whose chief complaint was deafness, was a healthy looking child and well nourished. The mother was in fair health, except that she was tuberculous and slightly deaf. The grandmother and several uncles were deaf. The patient had a past history of measles, german measles and whooping cough at 5 years; earaches in infancy; headaches quite often in the past few months, mostly frontal. Six years previously she had had a cough, which lasted two years. The tonsils had been removed. There was dizziness at times and tinnitus in the right ear. She had been deaf for four or five years, the right ear being more affected.

Examination, August, 1920, revealed that the nose and throat were negative except that the voice was husky and the cords seemed flabby. Examination of the ears revealed a slight retraction of the right membrana tympani. The left

membrana tympani was pink. The right tube was narrow. The hearing was:

	0	1"	poor	ac < bc > n
C ⁸⁴	—	C	—	C ⁴ —
	1"	3"	poor	ac < bc > n
	Limit			6"
Galton	—			W. V. —
	Limit			18"

Weber to right.

The blood Wassermann was negative.

Vestibular examination (entire test at one sitting) (Fig. 10) revealed subnormal nystagmus, vertigo and past pointing; no responses from verticals or horizontals after douching right ear, no responses from verticals of the left ear; good nystagmus from left horizontal but reversed past pointing. Three days later, the douching was repeated with identical results.

The picture was that of a right angle lesion except that there was some hearing in the right ear, but it is poor in both ears.

Eighteen months later reexamination in two stages (Fig. 11) revealed a slight increase in deafness for high tones; nystagmus after turning subnormal and vertigo responses very much diminished; past pointing to right on turning in both directions.

The striking change was apparent on douching. Whereas at the first examination no nystagmus was elicited from any canal except the left horizontal, we now got responses from all canals, although, to be sure, the reaction from the verticals was poor. On turning with the head back 60 degrees there was rotary nystagmus of good amplitude and duration.

The interpretation of these findings was very difficult. While the findings at the first test pointed strongly to some lesion growing toward the angle on the right side, the findings in the last examination seemed to upset this hypothesis completely.

The difficult question to determine was, "Has this patient an intracranial lesion?" The results of the last vestibular test, considered in connection with the high degree of deafness in both ears, suggested a bilateral peripheral lesion. This case

also illustrates the advantage of reexaminations. It is tentatively included in the group of intracranial lesions, but will be studied further.

Case 9.—Dr. J. W. H., aged 37, sustained a basal fracture in an accident five months previously. He was unconscious for three days, bleeding from both ears. When consciousness returned, he was dizzy on sitting up or turning the head to the right. There was right facial paralysis.

All symptoms were now much improved. The patient was dizzy, and there was deafness in the right ear. The right facial muscles were still weak. The membrana tympani was thickened. Hearing was poor for the high tones in the right ear; fair in the left ear.

On vestibular examination, at one sitting (Fig. 12), there was spontaneous crossed past pointing; Romberg sign; little swaying. Poor nystagmus and vertigo were noted after turning. The patient past pointed correctly on turning to the right but faulted with both hands after turning to left. Falling was correct after turning in each direction with the head 120 degrees forward.

On douching, there were no responses from the right ear, and none from the verticals of the left ear, but there were good nystagmus and vertigo from the left horizontal; past pointing was the same as spontaneous.

The picture is similar to that of an angle lesion. The man had either an injury to both labyrinths or it is possible there was a clot in the right angle.

Case 10.—Mr. W. L., aged 22, referred, Feb. 7, 1922, by a neurologist, on account of failing vision, vertigo and convulsions, gave a history of convulsions for eighteen months which were described as follows: face flushed, fingers grip and he falls if standing; becomes unconscious "but can keep talking"; no rigidity nor jerking but if he takes hold of bystander he hangs on; no frothing nor tongue biting. The patient said that his eyes had been crossed for six months, although he was told a year previously that they were not straight. He had headaches in occiput close to axis, and when the pain became severe he had a convulsive attack and sometimes vomited. The head was flexed with vertex to the right and chin to the left. He walked fairly well, though at times, he said,

"It seems as if my feet wanted to go on ahead of me." He had not been able to read for six months. Vision in the right eye was poorer than in the left. He staggered sometimes; he deviated to the left on walking, and sometimes fell to the left and backward.

Neurologic examination revealed marked divergent strabismus, right eye especially being involved. The pupils reacted to light but not to accommodation; there were bilateral choked discs. The patient was able to count fingers at 12 inches (30 cm.) with the left eye, but was not able to count fingers at 4 inches (10 cm.) with the right eye. There was contraction of the upper visual field in left eye. Fields in right eye could not be taken on account of blindness. The eyes could not be raised above horizontal. The tongue protruded in midline without tremor. All other cranial nerves were negative. The reflexes were not significant. There was no adiadochokinesis. Finger to nose and heel to knee movements were normal. Occasionally there were sudden jerking movements of the shoulders, more marked on the left side. Romberg sign was negative. Percussion of the skull was negative, except for tenderness over occiput.

The patient denied venereal disease. The blood Wassermann reaction was + + + +. Blood examination revealed: Hemoglobin, 90 per cent; red blood cells, 5 million; polymorphonuclears, 65 per cent. The urine was negative. Examination of the spinal fluid revealed: Seven lymphocytes per cubic millimeter; globulin positive; no pus cells; Wassermann reaction + + + +.

Vestibular examination (Fig. 13), entire test at one sitting, revealed: No spontaneous nystagmus nor past pointing; Romberg sign: falls to left and backward in all positions of head. Turning produced exaggerated nystagmus and vertigo. On douching there was no nystagmus nor vertigo from right verticals but correct past pointing. There was good but delayed nystagmus from left verticals, with vertigo and correct past pointing, and good responses from both horizontals. No nausea, pallor or sweating was noted.

The hearing was good and drum membranes were intact. A report was made that the neurootologic tests pointed to a

supratentorial lesion on the right side, probably back of the frontal area.

The exaggeration of the nystagmus and vertigo with good past pointing seemed to rule out the posterior fossa. The fact that the right vertical showed lack of nystagmus and vertigo responses but did show good past pointing, while the horizontals and left verticals gave correct responses, indicated a right sided lesion near the brain stem. The phenomenon that the test was completed at one sitting without producing nausea or vomiting was suggestive of a posterior fossa lesion, but this was thought to be outweighed by the other findings.

The patient came in five weeks later with a history of no improvement and, in fact, vision was still further impaired. Antisyphilitic treatment had been instituted and was being pushed.

Another vestibular test (Fig. 14) yielded similar results: Spontaneous past pointing to right with left hand; negative Romberg sign. The nystagmus time was still further exaggerated; the right verticals still failed to show nystagmus or vertigo, but now, after douching, the nystagmus from the left vertical canals was perverted, there being a rotary nystagmus to the right in the left eye and a nystagmus downward obliquely and to the right in the right eye. The horizontals reacted well, but there was a tendency to conjugate deviation to the left after douching both ears.

A roentgenogram of the skull (Figs. 15 and 16) showed an enlarged sella, with erosion in the floor and a shadow in the sphenoid sinus, although no symptoms of pituitarism had been elicited. In spite of the latter and in view of his rapidly failing vision, it was thought that possibly a tumor was present in the sella and sphenoid and that a transsphenoid operation might give some relief to his blindness and afford time for a more intensive antisyphilitic treatment. During the operation, however, and before the sphenoid sinuses were entered, the patient suddenly had a hard convulsion and died on the table.

Necropsy revealed: Brain removed intact; convolutions flattened over the right hemisphere; definite sensation of resistance felt in the anterior part of the longitudinal fissure.

On section (Figs. 17 and 18), a tumor $1\frac{1}{4}$ by $1\frac{3}{8}$ by $2\frac{1}{2}$ inches (4.7 by 3.4 by 6.2 cm.) soft and reddish in color was

found. It was apparently attached to the floor of the third ventricle and extended upward into the lateral ventricles rather more toward the right side, reaching up to the corpus callosum. There was no direct pressure on the anterior end of the aqueduct of Sylvius. There was pressure on both optic tracts. The lateral ventricles were almost completely filled in their anterior part by the tumor. All structures in the floor of the third ventricle and in the anterior part of the partition between the two lateral ventricles were involved by the pressure.

The sella turcica was flattened on the right side. The floor of the sella was necrotic, and the hypophysis was found in the sphenoid sinus.

Microscopic examination revealed: Numerous polygonal cells with round and oval nuclei, which take stain deeply, growing in solid masses. Occasional islands of degenerated cerebral tissue were found among the cell masses. The diagnosis was glioma cerebri.

301 FERGUSON BUILDING.

REFERENCES.

1. Vail, H. H.: *Laryngoscope* 30:505 (Aug.) 1920.
2. Lyons, H. R.: *Ann. Otol. Rhinol. and Laryngol.* 29:898 (Dec.) 1920.
3. Since this was written, I have learned that Ingham and Jones reported a case at the American Otological Society meeting.

TESTS OF THE VESTIBULAR APPARATUS
Chart 1
SPONTANEOUS

Mrs. L.V.S. NYSTAGMUS		POINTING	
		RIGHT	LEFT
Looking to RIGHT 0	Shoulder from above	T	T
Looking to LEFT 0	Nystagmus		
Looking UP 0	Vertigo		
Looking DOWN 0	Fast-pointing		
	Falling		
	Romberg Negative		
	Turning head to right		
	Turning head to left		
	Attempt to overthrow		
TURNING			
To RIGHT →	To RIGHT		
Amp. Good	Shoulder from above	24" to R	8" to R
Duration 30 Sec.	Nystagmus	8 R	2 R
	Vertigo 15 sec.	2 R	T
	Fast-pointing Correct	T	
To LEFT ←	To LEFT		
Amp. Good	Shoulder from above	6" to L	6" to L
Duration 3 Sec.	Nystagmus	T	2 L
	Vertigo 15 sec	T	T
	Fast-pointing Correct		
CALORIC			
Douche RIGHT 0	Douche RIGHT		
Amp.	Shoulder from above	4 to R	2 to R
After 3 min. 43 sec.	Nystagmus 0		
	Vertigo Present		
	Fast-pointing Correct		
	Falling		
Head Back →		4 to R	6 to R
Amp. Tremendous			
Douche LEFT ←	Douche LEFT		
Amp. POOR	Shoulder from above	2 to L	2 to L
After 1 min. 35 sec.	Nystagmus Barely perceptible		
	Vertigo Present		
	Fast-pointing Correct		
	Falling		
Head Back ←		2 to L	2 to L
Amp. Wide			
Right eye tends to turn inward.			
Entire test at one sitting--no nausea, pallor or sweat.			

From Dr. L. H. Jones' Equilibrium and Vertigo.

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Fig. 1 (Case 1).—Results of vestibular examination.

Chart 2

Mrs. E.R.W.

TESTS OF THE VESTIBULAR APPARATUS

NYSTAGMUS		SPONTANEOUS		POINTING	
				RIGHT	LEFT
Looking to RIGHT	None	Shoulder from above		T	T
Looking to LEFT	None	Nystagmus None			
Looking UP	None	Vertigo Yes			
Looking DOWN	None	Past-pointing			
		Falling			
		Romberg Very slight swaying			
		Turning head to right			
		Turning head to left			
		Attempt to overthrow			
Hearing: C 64 5" 6" 6" good limit					
W.V. 20' 20' good Galt limit					
ac > bc < n					
ac > bc < n					
TURNING					
To RIGHT →		To RIGHT			
Amp. Small		Shoulder from above		12 to R	2 to R
Duration 17 Sec.		Nystagmus Subnormal		2 R	2 R
		Vertigo 5 sec.		T	8 R
		Past-pointing Exaggerated with L.H.			8 R
					8 R
To LEFT ←		To LEFT			
Amp. Small		Shoulder from above		8 to L	6 to L
Duration 18 Sec.		Nystagmus Subnormal		T	T
		Vertigo 5 sec.			
		Past-pointing Subnormal			
CALORIC					
Douche RIGHT	None	Douche RIGHT			
Amp.		Shoulder from above		T to	6 to R
After 2 min. 45 sec.		Nystagmus None			
		Vertigo Slight			
		Past-pointing Fault with R.H.			
		Falling			
Head Back →		Slight nausea		2 to R	6 to R
Amp. Fair.					
Douche LEFT		Douche LEFT			
Amp. Small		Shoulder from above		to L	to L
After 1 min. 37 sec.		Nystagmus Delayed			
		Vertigo Marked			
		Past-pointing Correct			
Head Back ←		Falling		1 to L	T to
Amp. Good.		Quite nauseated			

From Dr. I. H. Jones' Equilibrium and Vertigo.

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Fig 2 (Case 2).—Results of vestibular examination.

H.K.-16 yrs.

Chart 3
TESTS OF THE VESTIBULAR APPARATUS

NYSTAGMUS		SPONTANEOUS		POINTING	
				RIGHT T	LEFT 1 to L
Looking to RIGHT None	Shoulder from above				
Looking to LEFT None	Nystagmus None	<div style="border: 1px solid black; padding: 5px;"> Hearing: C⁶⁴ 3" 12" 4 good 4" 12" good W.V.---Weber---ac < 10 > n 20 > 20 = n </div>			
Looking UP None	Vertigo None				
Looking DOWN None	Past-pointing With L.H.				
	Falling				
	Romberg				
	Turning head to right				
	Turning head to left				
	Attempt to overthrow				
		TURNING			
To RIGHT →	To RIGHT				
Amp. Small	Shoulder from above	20 to R	T to		
Duration 16 Sec.		4 R	4 L		
	Nystagmus Subnormal	2 T	T		
	Vertigo 4 sec.		2 L		
	Past-pointing Fault with L.H.		T		
To LEFT ←	To LEFT				
Amp. Good	Shoulder from above	20 to L	10 to L		
Duration 24 Sec.		4 L	T		
	Nystagmus Good				
	Vertigo 10 sec.				
	Past-pointing Correct				
		CALORIC			
Douche RIGHT None	Douche RIGHT				
Amp.	Shoulder from above	T to	2 to L		
After 5 min. sec.					
	Nystagmus None				
	Vertigo (Nausea, sweat and pallor.)				
	Past-pointing None				
	Falling				
Head Back →		T to	4 to R		
Amp. Good					
Douche LEFT ←	Douche LEFT				
Amp. Small	Shoulder from above	2 to L	1 to L		
After 2 min. 30 sec					
	Nystagmus Barely perceptible				
	Vertigo yes.				
	Past-pointing Questionable				
	Falling				
Head Back ←		T to	T to		
Amp. Good					

Entire test at one sitting. Pallor, nausea, sweat. Head dropped forward and was apparently stupid. Tendency to fall forward.

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Fig. 3 (Case 3).—Results of vestibular examination.

TESTS OF THE VESTIBULAR APPARATUS			
Chart 4			
SPONTANEOUS			
NYSTAGMUS		POINTING	
		RIGHT	LEFT
Looking to RIGHT 0	Shoulder from above	T	T
Looking to LEFT 0			
Looking UP 0	Nystagmus		
	Vertigo Present		
	Past-pointing		
Looking DOWN 0	Falling Tends to fall to left		
	Romberg Slight swaying		
	Turning head to right same		
	Turning head to left same		
	Attempt to overthrow		
TURNING			
To RIGHT →	To RIGHT		
Amp. Good	Shoulder from above	12 to R	15 to R
Duration 30 Sec.		6 R	6 R
	Nystagmus	3 R	1 R
	Vertigo 23 sec	2 R	T
	Past-pointing Correct	T	
To LEFT ←	To LEFT		
Amp. Good	Shoulder from above	12 to L	12 to L
Duration 30 Sec.		T	3 L
	Nystagmus	T	2 L
	Vertigo 19 sec		2 L
	Past-pointing Correct.		T
CALORIC			
Douche RIGHT 0	Douche RIGHT		
Amp.	Shoulder from above	T to	6 to R
After 3 min. 10 sec.			
	Nystagmus		
	Vertigo slight		
	Past-pointing Fault with R.H.		
	Falling		
Head Back →		T to	6 to R
Amp. Small, slow			
Douche LEFT ↶	Douche LEFT		
Amp. almost none	Shoulder from above	T to	T to
After 1 min. 24 sec.			
	Nystagmus Poor reaction		
	Vertigo slight		
	Past-pointing None		
	Falling		
Head Back ←		T to	T to
Amp. Good			

Examined in two sittings. Vomited after getting home.

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Fig. 4 (Case 4).—Results of vestibular examination.

TESTS OF THE VESTIBULAR APPARATUS			
Chart 5			
SPONTANEOUS			
A.P.M.		POINTING	
NYSTAGMUS		RIGHT	LEFT
Looking to RIGHT 0	Shoulder from above	4 to R	T
Looking to LEFT 0	Nystagmus	T	3 to R
Looking UP 0	Vertigo		
Looking DOWN 0	Past-pointing		
	Falling		
	Romberg Negative		
	Turning head to right		
	Turning head to left		
	Attempt to overthrow		
TURNING			
To RIGHT →	To RIGHT		
Amp. Good	Shoulder from above	4 to R	4 to R
Duration 17 Sec.	Nystagmus	1 T	4 R
	Vertigo 17 sec.		3 R
	Past-pointing Correct		T
To LEFT ←	To LEFT		
Amp. Good	Shoulder from above	6 to L	6 to L
Duration 23 Sec.	Nystagmus	2 L	2 L
	Vertigo 23 sec.	2 R	2 R
	Past-pointing Correct		
CALORIC			
Douche RIGHT 0	Douche RIGHT		
Amp.	Shoulder from above	T to	T to
After 3 min. 55 sec.	Nystagmus		
	Vertigo NONE		
	Past-pointing NONE		
	Falling		
Head Back →	Dizzy	T to	2 to R
Amp. Good			
Douche LEFT 0	Douche LEFT		
Amp.	Shoulder from above	2 to L	1 to R
After 4 min. 23 sec.	Nystagmus		
	Vertigo NONE		
	Past-pointing Crossed		
	Falling		
Head Back ←	Slight vertigo.	2 to L	1 to R
Amp. Wide	Examined in two sittings.		

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Fig. 5 (Case 5).—Results of vestibular examination.

TESTS OF THE VESTIBULAR APPARATUS			
Chart 6			
SPONTANEOUS			
NYSTAGMUS		POINTING	
		RIGHT	LEFT
Looking to RIGHT 0	Shoulder from above		
Looking to LEFT 0	Nystagmus	T	T
Looking UP 0	Vertigo		
Looking DOWN 0	Past-pointing		
	Falling		
	Romberg Falls backward		
	Turning head to right ditto		
	Turning head to left ditto		
	Attempt to overthrow		
TURNING			
To RIGHT →	To RIGHT		
Amp. Small	Shoulder from above	2 to R	4 to R
Duration 16 Sec.	Nystagmus Subnormal	2 R	4 R
	Vertigo 14 sec	T	2 R
	Past-pointing Correct		2 R
			T
To LEFT ←	To LEFT		
Amp. Small	Shoulder from above	1 to L	T to
Duration 17 Sec.	Nystagmus Subnormal	2 L	T
	Vertigo 22 sec.	2 L	T
	Past-pointing Fault, L.H.	2 L	T
CALORIC			
Douche RIGHT 0	Douche RIGHT		
Amp.	Shoulder from above	1 to L	T to
After 5 min. sec.	Nystagmus None		
	Vertigo None		
	Past-pointing None		
	Falling to right		
Head Back →	Dizzy.	T to	3 to R
Amp. very fine			
Douche LEFT	Douche LEFT		
Amp. Poor	Shoulder from above	1 to L	T to
After 5 min. sec.	Nystagmus Barely a trace		
	Vertigo None		
	Past-pointing None		
	Falling slightly to right		
Head Back ↖	Slightly dizzy	1 to L	T to
Amp. Fair			

Test in two sittings. No nausea, pallor or sweat.

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Fig. 6 (Case 6).—Results of first vestibular examination.

TESTS OF THE VESTIBULAR APPARATUS			
Chart 7			
SPONTANEOUS			
NYSTAGMUS		POINTING	
		RIGHT T	LEFT T
Looking to RIGHT 0	Shoulder from above		
Looking to LEFT 0	Nystagmus		
Looking UP 0	Vertigo		
Looking DOWN 0	Past-pointing		
	Falling		
	Romberg		
	Sways to right & back		
	Turning head to right same		
	Turning head to left steady		
	Attempt to overthrow		
TURNING			
To RIGHT →	To RIGHT		
Amp. Fair	Shoulder from above	4 to R	6 to R
Duration 19Sec.		T	R
	Nystagmus		
	Vertigo 23 sec.		
	Past-pointing Correct		T
To LEFT ←	To LEFT		
Amp. Small	Shoulder from above	T to	T to
Duration 19Sec.			
	Nystagmus		
	Vertigo 23 sec.		
	Past-pointing		
CALORIC			
Douche RIGHT ↘	Douche RIGHT		
Amp. Poor	Shoulder from above	T to	T to
After 3 min. 4 sec			
	Nystagmus Did not improve		
	Vertigo None		
	Past-pointing None		
	Falling		
Head Back →	Dizzy	1 to R	1 to R
Amp. Good.			
Douche LEFT ↙	Douche LEFT		
Amp. Very poor	Shoulder from above	1 to L	T to
After 2 min. 25sec.			
	Nystagmus Did not improve		
	Vertigo None		
	Past-pointing Fault, L.H.		
	Falling		
Head Back ↗		1 to L	1 to L
Amp. Fair			
Entire test at one sitting--no nausea, pallor or sweat.			

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Fig. 7 (Case 6).—Results of second vestibular examination.

Miss M. S.

TESTS OF THE VESTIBULAR APPARATUS

Chart 8

SPONTANEOUS

NYSTAGMUS

Looking to RIGHT ←
Looking to LEFT →
Looking UP ↑ ↗
Looking DOWN 0

Shoulder from above
Nystagmus
Vertigo
Past-pointing
Falling
Romberg Falls to left
Turning head to right Falls to left
Turning head to left Falls backward
Attempt to overthrow

POINTING
RIGHT T
LEFT 4 to L

TURNING

To RIGHT →
Amp. Poor
Duration 11Sec.

To RIGHT
Shoulder from above
Nystagmus Subnormal
Vertigo 13 sec
Past-pointing Not taken

to

to

To LEFT ←
Amp. Good
Duration 41Sec.

To LEFT
Shoulder from above
Nystagmus
Vertigo 11 sec
Past-pointing Not taken

to

to

CALORIC

Douche RIGHT 0
Amp.
After 4 min. sec.

Douche RIGHT
Shoulder from above
Nystagmus
Vertigo
Past-pointing
Falling

4 to R

4 to R

Head Back →
Amp. Wide; tendency to conjugate deviation.

10 to R

10 to R

Douche LEFT 0
Amp.
After 3 min 55 sec.

Douche LEFT
Shoulder from above
Nystagmus
Vertigo
Past-pointing
Falling

T to

4 to L

Head Back ←
Amp. Small; tendency to conjugate deviation.

T to

4 to R

Test in two sittings.

From Dr. I. H. Jones' Equilibrium and Vertigo.

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Fig. 8 (Case 7).—Results of first vestibular examination.

TESTS OF THE VESTIBULAR APPARATUS			
Chart 9			
SPONTANEOUS			
Miss M.G.			
NYSTAGMUS			
Looking to RIGHT 0	Shoulder from above	POINTING RIGHT T	LEFT 2 to R
Looking to LEFT 0	Nystagmus 0		
Looking UP 0	Vertigo 0		
Looking DOWN 0	Past-pointing With L.H.		
	Falling		
	Romberg Negative		
	Turning head to right		
	Turning head to left		
	Attempt to overthrow		
TURNING			
To RIGHT →	To RIGHT		
Amp. Good	Shoulder from above	to	to
Duration 26 Sec.	Nystagmus Normal		
	Vertigo 23 sec.		
	Past-pointing Not taken		
To LEFT ←	To LEFT		
Amp. Good	Shoulder from above	to	to
Duration 31 Sec.	Nystagmus		
	Vertigo 24 sec.		
	Past-pointing Not taken		
CALORIC			
Douche RIGHT 0	Douche RIGHT		
Amp.	Shoulder from above	T to	2 to R
After 3 min 35 sec.	Nystagmus None		
	Vertigo Slight		
	Past-pointing Fault, R.H.		
	Falling To right		
Head Back →	Dizzy--nauseated	½ to R	4 to R
Amp. Good			
Douche LEFT 0	Douche LEFT		
Amp.	Shoulder from above	T to	2 to R
After 1 min. 52 sec.	Nystagmus None		
Vomited	Vertigo Began at 1 min.		
	Past-pointing Fault, both hands		
	Falling	3 to L	2 to R
Head Back ←			
Amp. Good			
Entire examination at one sitting.			

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Fig. 9 (Case 7).—Results of second vestibular examination.

Chart 10

1. M- Age 14

TESTS OF THE VESTIBULAR APPARATUS

NYSTAGMUS		SPONTANEOUS		POINTING	
				RIGHT	LEFT
Looking to RIGHT	None	Shoulder from above		2	2
Looking to LEFT	None				
Looking UP	None	Nystagmus None			
Looking DOWN	None	Verigo Yes			
		Fast-pointing None			
		Falling			
		Romberg No swaying			
		Turning head to right			
		Turning head to left			
		Attempt to overthrow	Pelvic movements normal		
TURNING					
To RIGHT →		To RIGHT			
Amp. Fair- slow		Shoulder from above	2" to R	T to	
Duration 15 Sec.		Nystagmus subnormal			
		Verigo 9 sec.			
		Fast-pointing Fault			
To LEFT ←		To LEFT			
Amp. Fair- slow		Shoulder from above	T to	T to	
Duration 15 Sec.		Nystagmus subnormal			
		Verigo 10 sec.			
		Fast-pointing None			
CALORIC					
Douche RIGHT	None	Douche RIGHT			
Amp.		Shoulder from above	T to	T to	
After 4 min. 5 sec.		Nystagmus None			
		Verigo None			
		Fast-pointing None			
		Falling			
Head Back	None		T to	T to	
Amp.					
Douche LEFT	None	Douche LEFT			
Amp.		Shoulder from above	T to	T to	
After 5 min. 6 sec.		Nystagmus None			
		Verigo None			
		Fast-pointing None			
		Falling			
Head Back ←			8" to R	8" to R	
Amp. Good- slow					

Entire test at one sitting; slight nausea--did not vomit.

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Fig. 10 (Case 8).—Results of first vestibular examination.

Chart 11

TESTS OF THE VESTIBULAR APPARATUS

NYSTAGMUS		SPONTANEOUS		POINTING	
				RIGHT	LEFT
Looking to RIGHT None		Shoulder from above		T	T
Looking to LEFT None					
Looking UP None		Nystagmus None		<div>Turning, head back 60°</div> <div>To right ↗ Amp. Fair Duration 14 sec</div> <div>To left ↖ Amp. Good Duration 15 sec</div>	
Looking DOWN None		Vertigo Very little			
		Past-pointing None			
		Falling			
		Romberg No swaying			
		Turning head to right			
		Turning head to left			
		Attempt to overthrow			
		TURNING			
To RIGHT →		To RIGHT			
Amp. Fair		Shoulder from above		4 to R	2 to R
Duration 16 Sec.				3 R	2 R
		Nystagmus Subnormal		2 R	2 R
		Vertigo 4 sec.		T	T
		Past-pointing Correct			
To LEFT ←		To LEFT			
Amp. Good		Shoulder from above		2 to R	4 to R
Duration 18 Sec.				T	2 R
		Nystagmus Subnormal			T
		Vertigo 5 sec.			
		Past-pointing Reversed			
		CALORIC			
Douche RIGHT ↗		Douche RIGHT			
Amp. Small-poor		Shoulder from above		1 to R	T to
After 3 min. 55 sec.					
		Nystagmus Poor			
		Vertigo Very little			
		Past-pointing Fault with L.H.			
		Falling			
Head Back →		Slight vertigo		4 to R	4 to R
Amp. Good					
Douche LEFT ↖		Douche LEFT			
Amp. Small-poor		Shoulder from above		1 to R	1 to L
After 2 min. 10 sec.					
		Nystagmus Poor			
		Vertigo None			
		Past-pointing Reversed with R.H.			
		Falling			
Head Back ←		Slight vertigo.		1 to L	1 to L
Amp. Good					

Test in two sittings; nauseated but did not vomit

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Fig. 11 (Case 8).—Results of second vestibular examination.

Chart 12

Dr. J. W. H.

TESTS OF THE VESTIBULAR APPARATUS

NYSTAGMUS		SPONTANEOUS	POINTING	
			RIGHT	LEFT
Looking to RIGHT	None	Shoulder from above	2 to L	2 to R
Looking to LEFT	None	Nystagmus None		
Looking UP	None	Vertigo Yes		
Looking DOWN	None	Fast-pointing Crossed		
		Falling		
		Romberg Negative		
		Turning head to right		
		Turning head to left		
		Attempt to overthrow		
		Deviates to right on walking with closed eyes		
TURNING				
To RIGHT →		To RIGHT		
Amp. Small		Shoulder from above	21 to R	6 to R
Duration 9 Sec.		Nystagmus Subnormal	2 R	2 R
		Vertigo 11 sec.	T	T
		Fast-pointing Correct		
		Falls to right--slight.		
To LEFT ←		To LEFT		
Amp. Small		Shoulder from above	T to	4 to R
Duration 4 Sec.		Nystagmus Subnormal	T	2 R
		Vertigo 3 sec.	T	2 T
		Fast-pointing Reversed with L.H.		
		Falls to left--marked.		
CALORIC				
Douche RIGHT	None	Douche RIGHT		
Amp.		Shoulder from above	2 to L	2 to R
After 5 min. sec.		Nystagmus None		
		Vertigo None		
		Fast-pointing Same as spontaneous		
		Falling To right		
Head Back	None		2 to L	2 to R
Amp.				
Douche LEFT	None	Douche LEFT		
Amp.		Shoulder from above	2 to L	2 to R
After 5 min. sec.		Nystagmus None		
		Vertigo None		
		Fast-pointing Same as spontaneous		
		Falling		
Head Back ←			2 to L	2 to R
Amp. Good		Is dizzy		

Entire test at one sitting. No nausea, pallor or sweat.

From Dr. L. H. Jones' Equilibrium and Vertigo.

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Fig. 12 (Case 9).—Results of vestibular examination.

TESTS OF THE VESTIBULAR APPARATUS
W.L. - Chart 15
SPONTANEOUS

NYSTAGMUS		POINTING	
		RIGHT	LEFT
Looking to RIGHT 0	Shoulder from above	T	T
Looking to LEFT 0			
Looking UP 0	Nystagmus		
Looking DOWN 0	Vertigo		
	Past-pointing		
	Falling		
	Romberg		
	Falls to left and back		
	Turning head to right		
	Turning head to left		
	Attempt to overthrow		
TURNING			
To RIGHT →	To RIGHT		
Amp. Wide	Shoulder from above	to	to
Duration 43 Sec.			
	Nystagmus		
	Vertigo 33 sec		
	Past-pointing		
To LEFT ←	To LEFT		
Amp. Wide	Shoulder from above	to	to
Duration 34 Sec.			
	Nystagmus		
	Vertigo 31 sec.		
	Past-pointing		
CALORIC			
Douche RIGHT 0	Douche RIGHT		
Amp.	Shoulder from above	6" to R	6" to R
After 5 min. sec.			
	Nystagmus None		
	Vertigo None		
	Past-pointing Correct		
	Falling To right		
Head Back →	Vertigo	6" to R	12" to R
Amp. Wide			
Douche LEFT 0	Douche LEFT		
Amp. GOOD	Shoulder from above	4" to L	6" to L
After 1 min. 50 sec.			
	Nystagmus Delayed		
	Vertigo Present		
	Past-pointing Correct		
	Falling To left		
Head Back ←	Vertigo marked	8" to L	4" to L
Amp. Wide			
Tendency to conjugate deviation.			
	Entire test at one sitting.		

From Dr. I. H. Jones' Equilibrium and Vertigo.

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Fig. 13 (Case 10)—Results of first vestibular examination.

TESTS OF THE VESTIBULAR APPARATUS

Chart 14

SPONTANEOUS
W.L. 22

NYSTAGMUS		POINTING	
		RIGHT T	LEFT 2" to R
Looking to RIGHT 0	Shoulder from above		
Looking to LEFT 0	Nystagmus		
Looking UP 0	Vertigo		
Looking DOWN 0	Past-pointing		
	Falling		
	Romberg Negative		
	Turning head to right		
	Turning head to left		
	Attempt to overthrow		
TURNING			
To RIGHT →	To RIGHT		
Amp. Wide	Shoulder from above	to	to
Duration 60 Sec.	Nystagmus Exaggerated		
	Vertigo 24 sec.		
	Past-pointing		
To LEFT ←	To LEFT		
Amp. Wide	Shoulder from above	to	to
Duration 37 Sec.	Nystagmus		
	Vertigo 34 sec		
	Past-pointing		
CALORIC			
Douche RIGHT 0	Douche RIGHT		
Amp.	Shoulder from above	6" to R	8" to R
After 5 min. sec.	Nystagmus None		
	Vertigo None		
	Past-pointing Correct		
	Falling		
Head Back →	Head Back		
Amp. Wide,	tendency to conjugate deviation	6" to R	14" to R
Douche LEFT ↺ ↻	Douche LEFT		
Amp. Good	Shoulder from above	6" to L	1" to L
After 1 min 30 sec.	Nystagmus Perverted		
✓ in R eye	Vertigo None		
✓ in L eye	Past-pointing correct		
	Falling		
Head Back ←	Head Back		
Amp. Good	No vertigo	6" to L	7" to
	tendency to conjugate deviation		

Entire test at one sitting

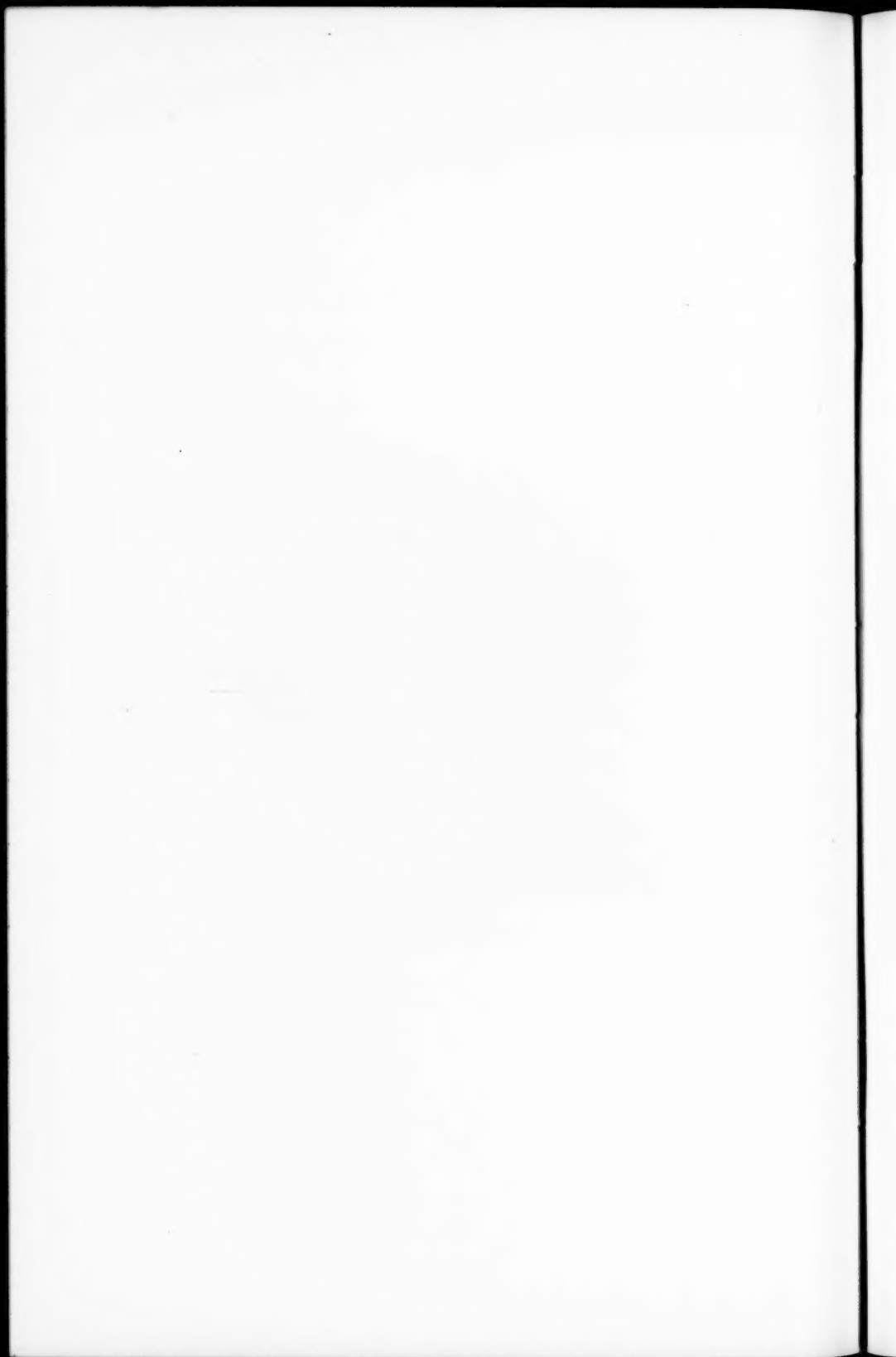
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Fig. 14 (Case 10).—Results of second vestibular examination.



Fig. 15 (Case 10).—Location of enlarged sella, showing erosion in the floor and a shadow in the sphenoid sinus.



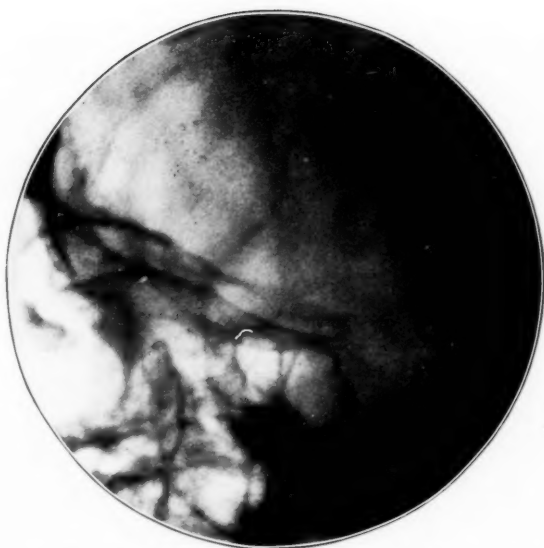
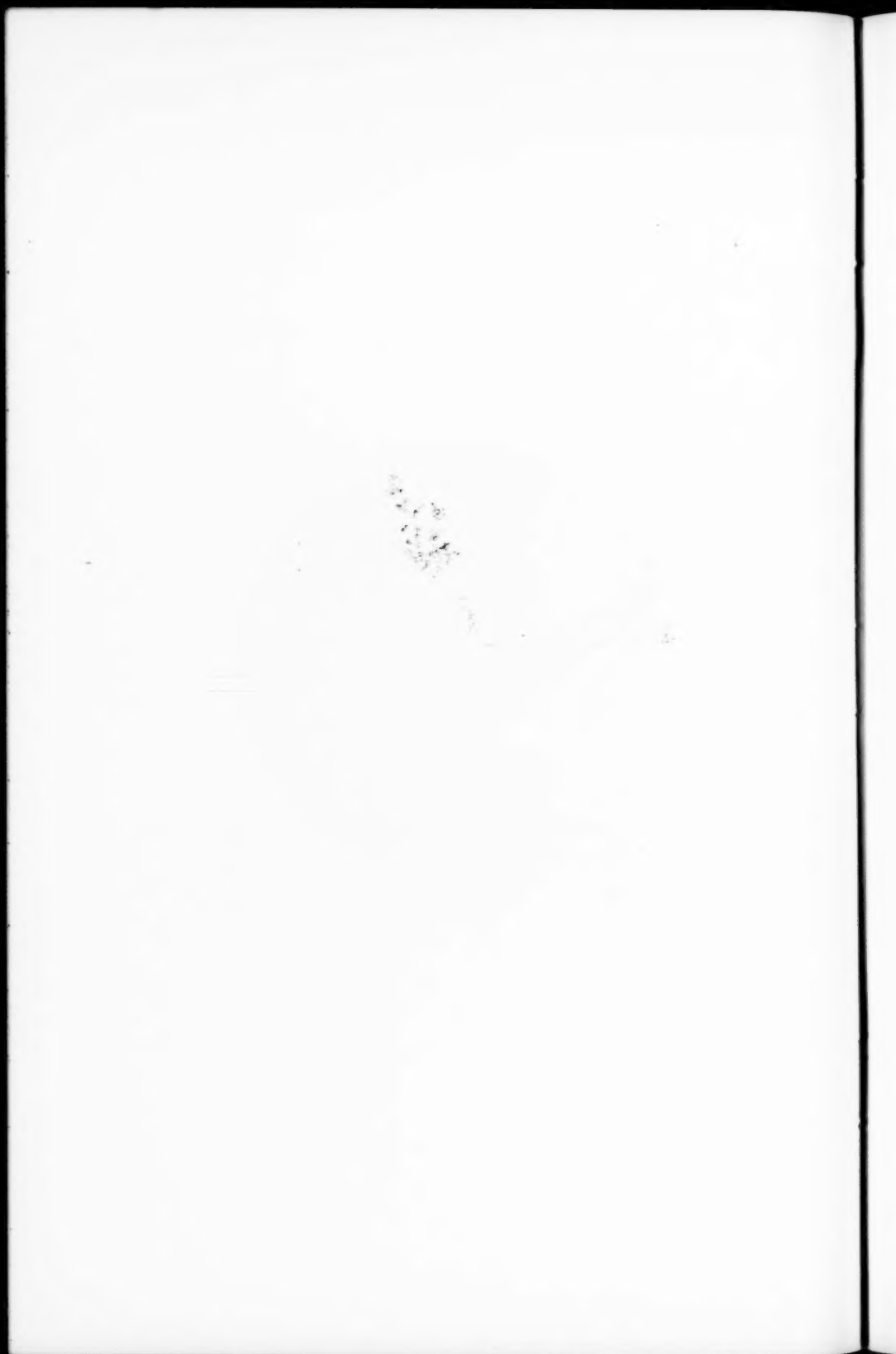


Fig. 16 (Case 10).—Enlarged sella, erosion in floor and shadow in the sphenoid sinus.



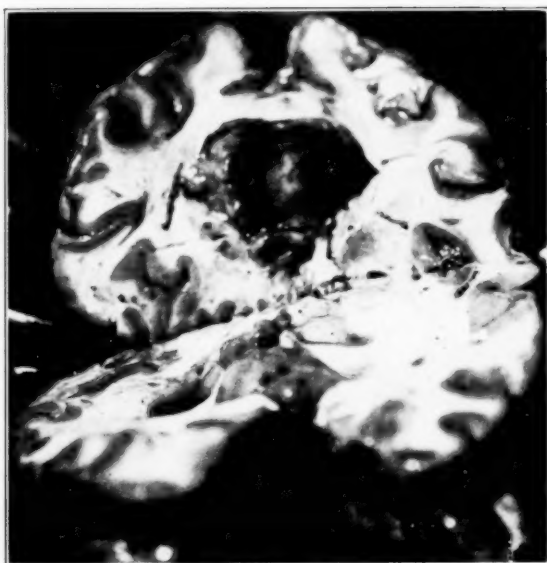


Fig. 17 (Case 10).—Frontal section of brain.

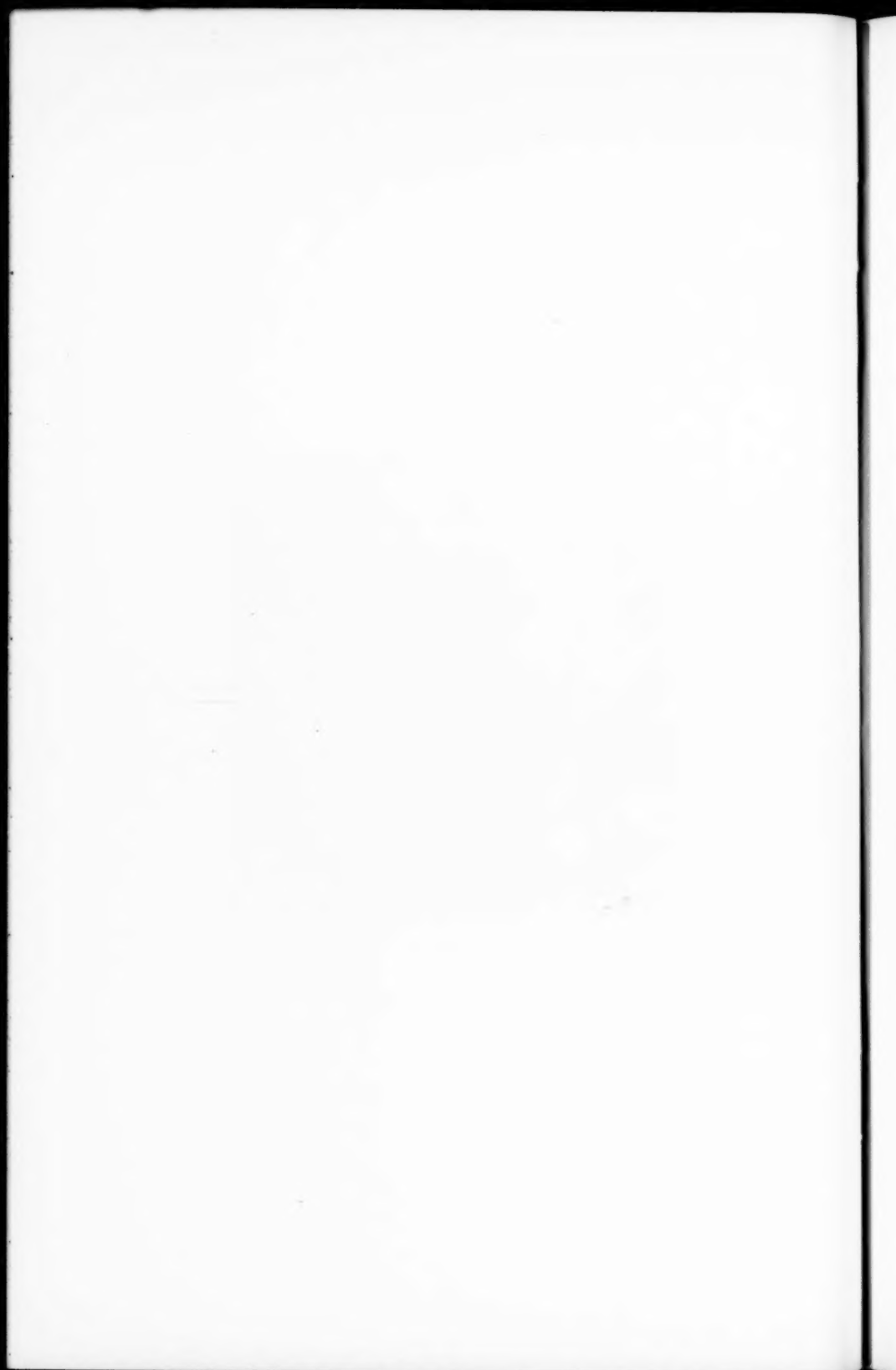
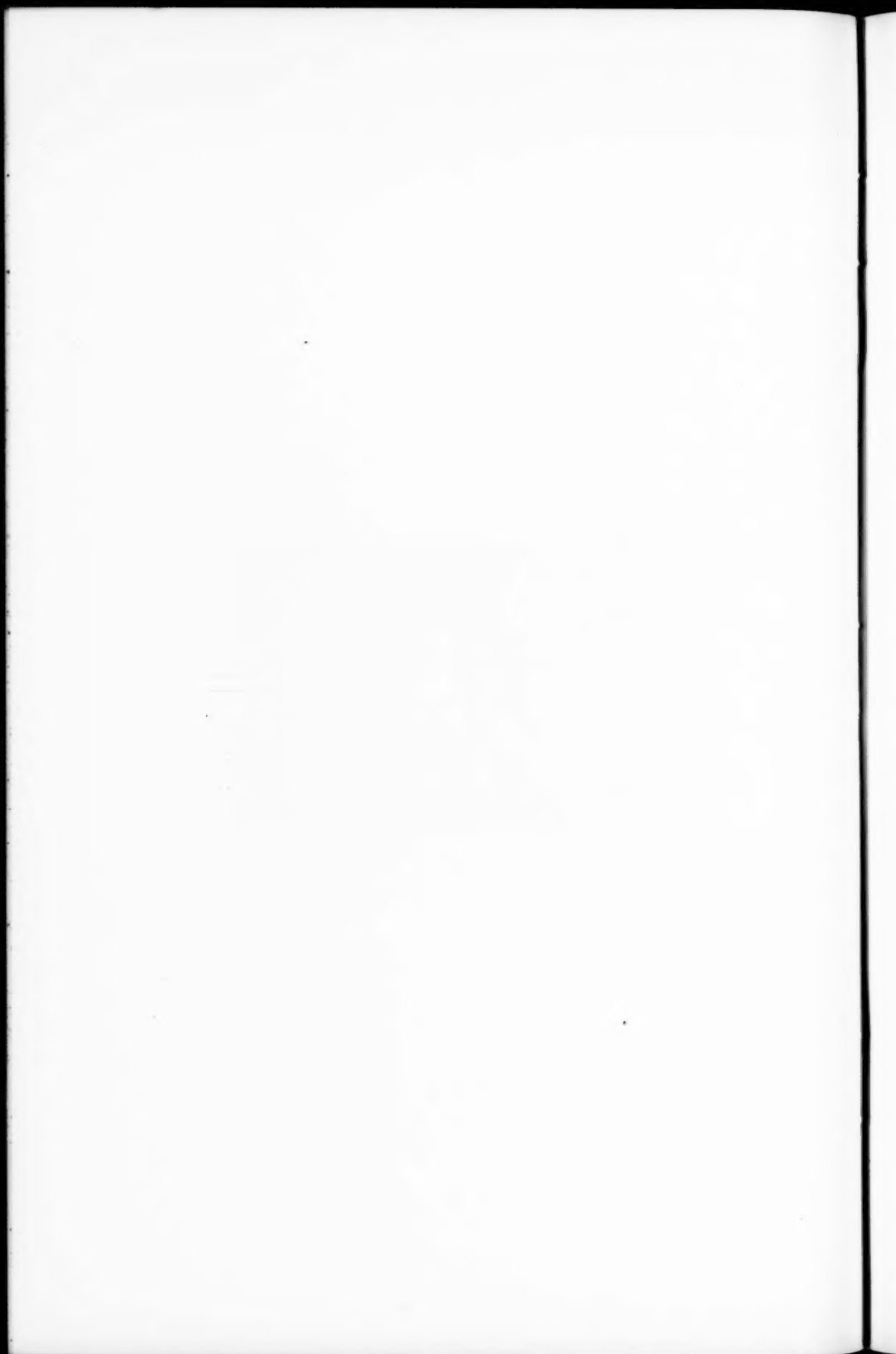




Fig. 18 (Case 10).—Longitudinal section of brain.



XIII.

A SIMPLE KNOT FOR INTRANASAL SUTURES.*

BY WILSON JOHNSTON, M. D.,

PORTLAND, OREGON.

The placing and tying of ligatures and sutures in locations not freely accessible, as in the nose and throat, is always difficult. Anything that tends to remove this difficulty needs no apology for being presented to the profession.

I have used this knot for a number of years and conceived the idea from seeing a surgeon lock a double threaded, continuous suture before tying it. The knot is applicable to all ligatures and sutures placed by a needle on a handle, a needle with the eye in the point, or a needle of the crochet hook type. Whatever the type of needle selected, it must be armed with a double suture and passed through both flaps of the wound. The thread is seized by a hook or a pair of forceps, just back of the eye of the needle (Fig. 1) and held fast while the needle is pushed back along the path of entrance and disengaged from the suture (Fig. II). We now have a loop of suture on one side of the wound and two free ends on the other. Pass one free end through the loop (Fig. III) and make traction on both free ends of the suture. This causes the loop to slip down toward the wound, brings the parts in apposition and draws a tight, secure knot.

In wounds where no tension is expected, this knot is sufficient if the suture is cut so as to leave the ends a quarter to a half inch long. In the majority of wounds it should be reinforced by a loop of the ordinary square knot (Fig. IV). When so reinforced it can be removed, if necessary, by catching one of the free ends with a forcep and making a to and fro motion which causes the reinforcing loop to untie and the suture slips on gentle traction.

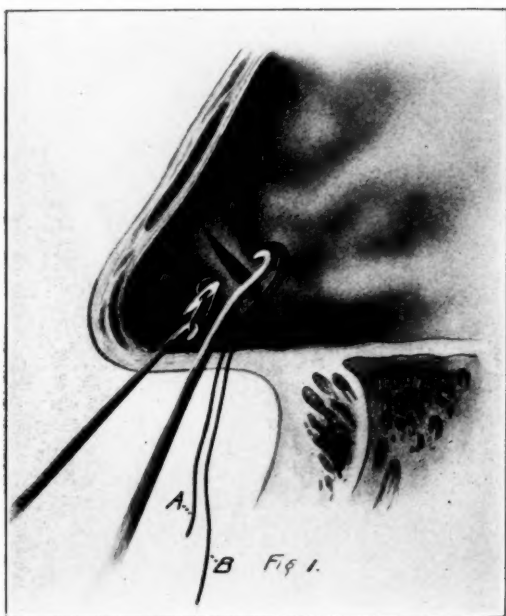
*Read before the Pacific Coast Oto-Ophthalmologic Society at Salt Lake City, Utah, September 15, 1922.

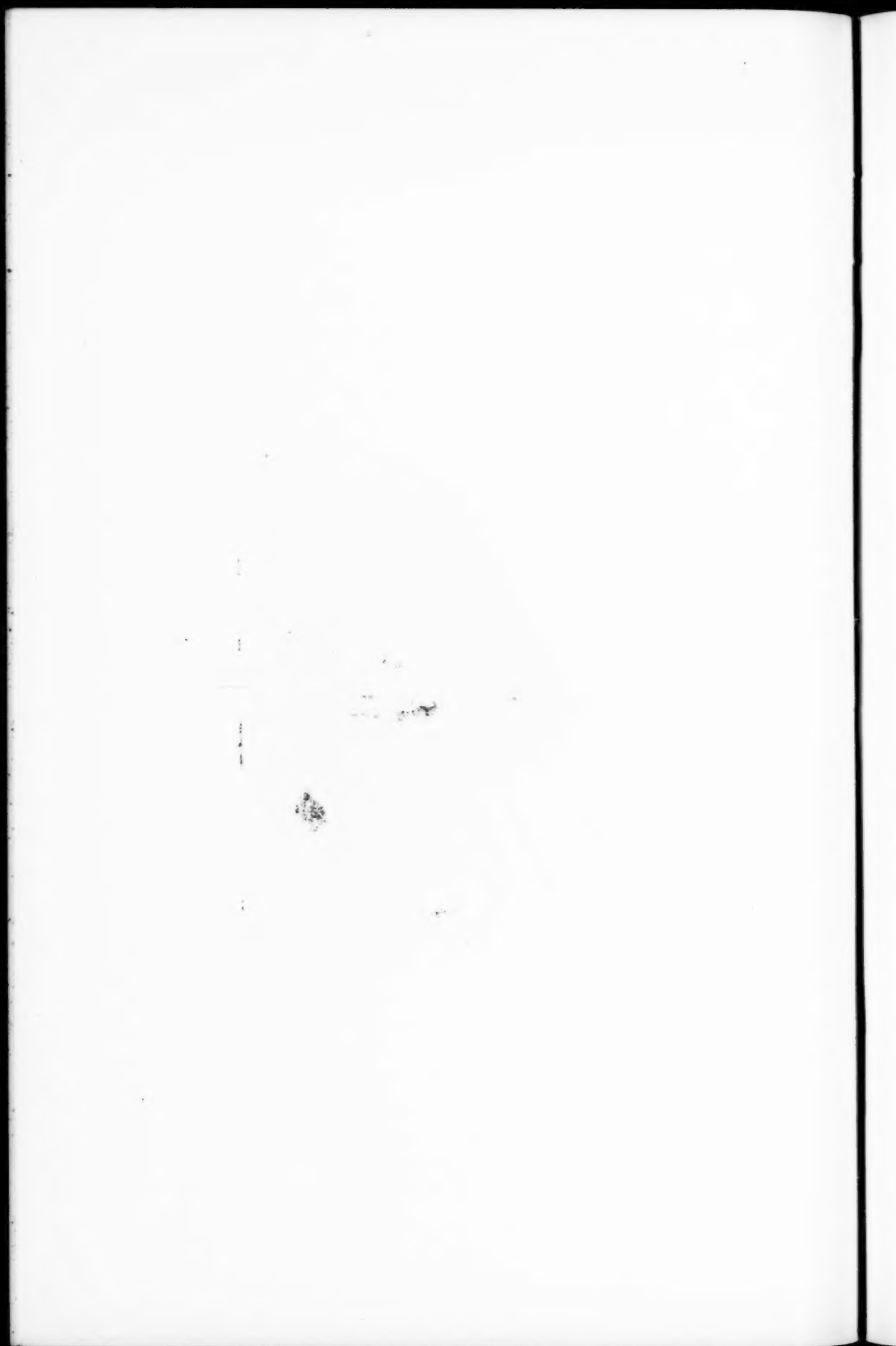
When used to tie ligatures, the knot should be reinforced with several loops of the square knot.

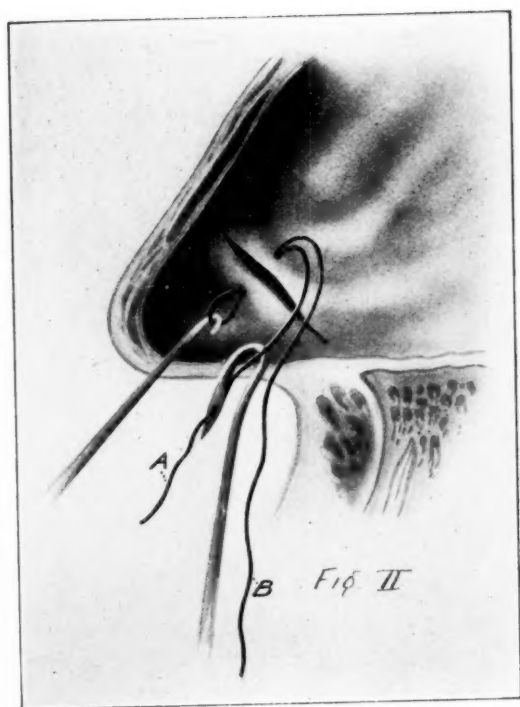
In an emergency, when a needle on a handle is not convenient, an ordinary surgical needle and needle holder may be used. The needle must be threaded with an extra long double suture, which is drawn well through the flap of the wound. The needle is then cut off and the free ends on that side tied, thus reestablishing the loop, and the knot can be tied as described.

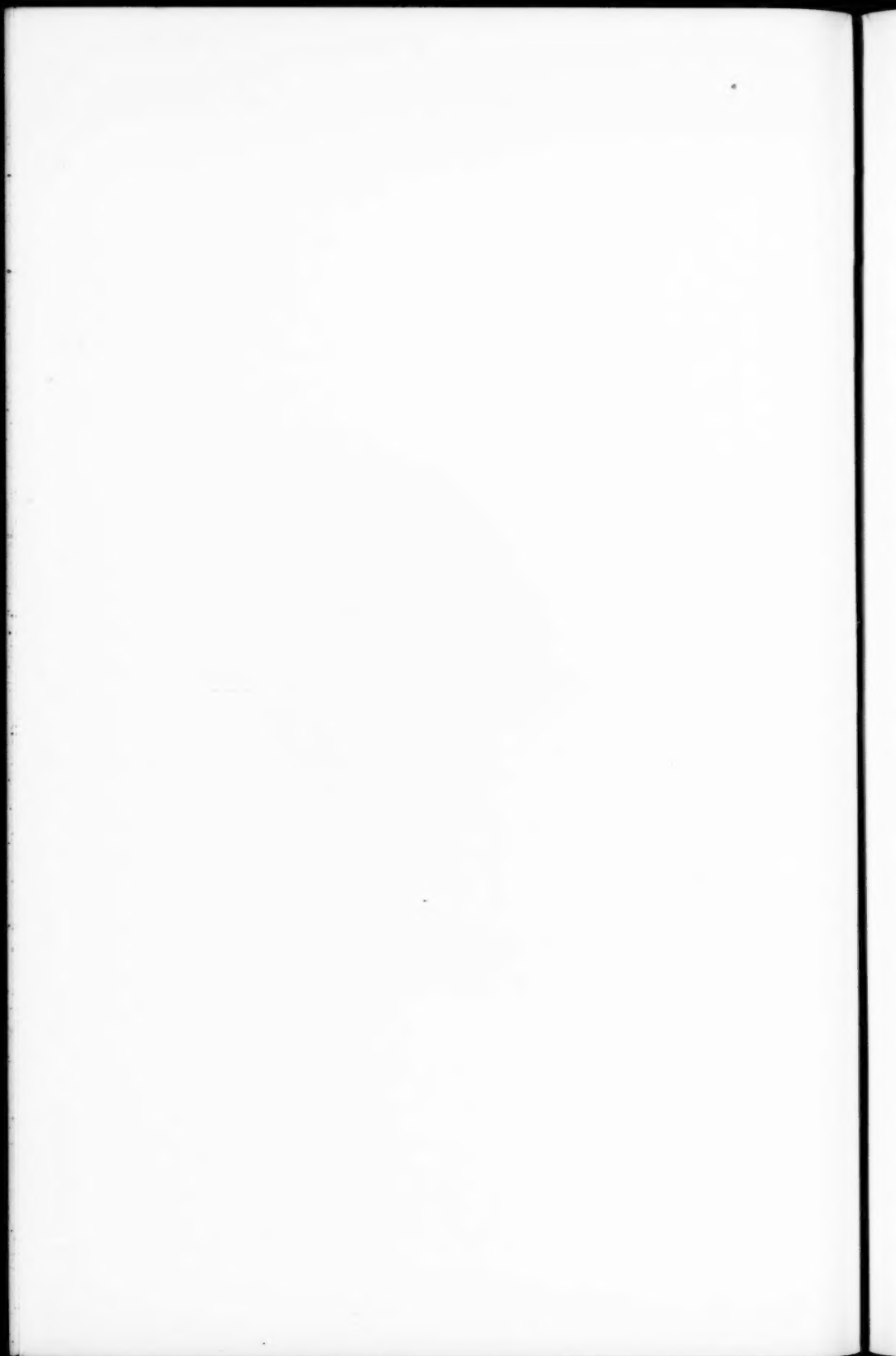
I believe this knot has the following advantages :

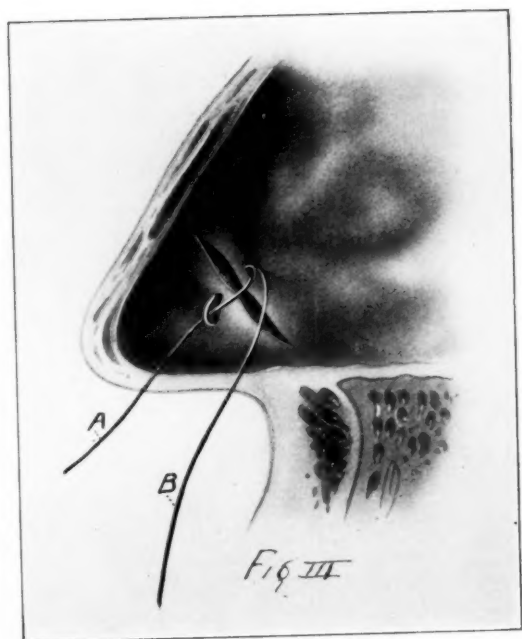
1. Is simple.
2. Easily tied.
3. Reliable ; will hold.
4. Requires no special instruments.
5. Easily removed.

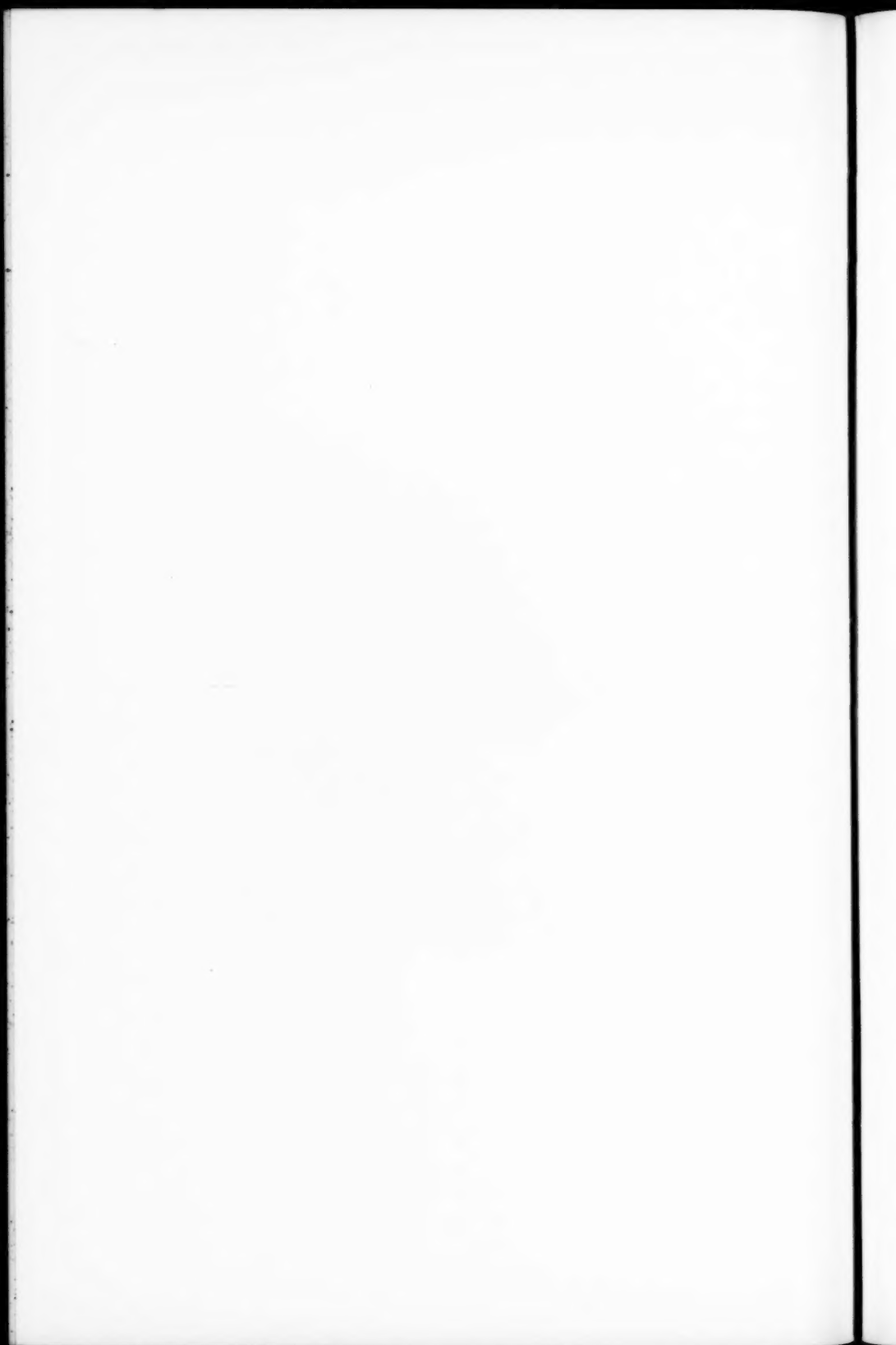




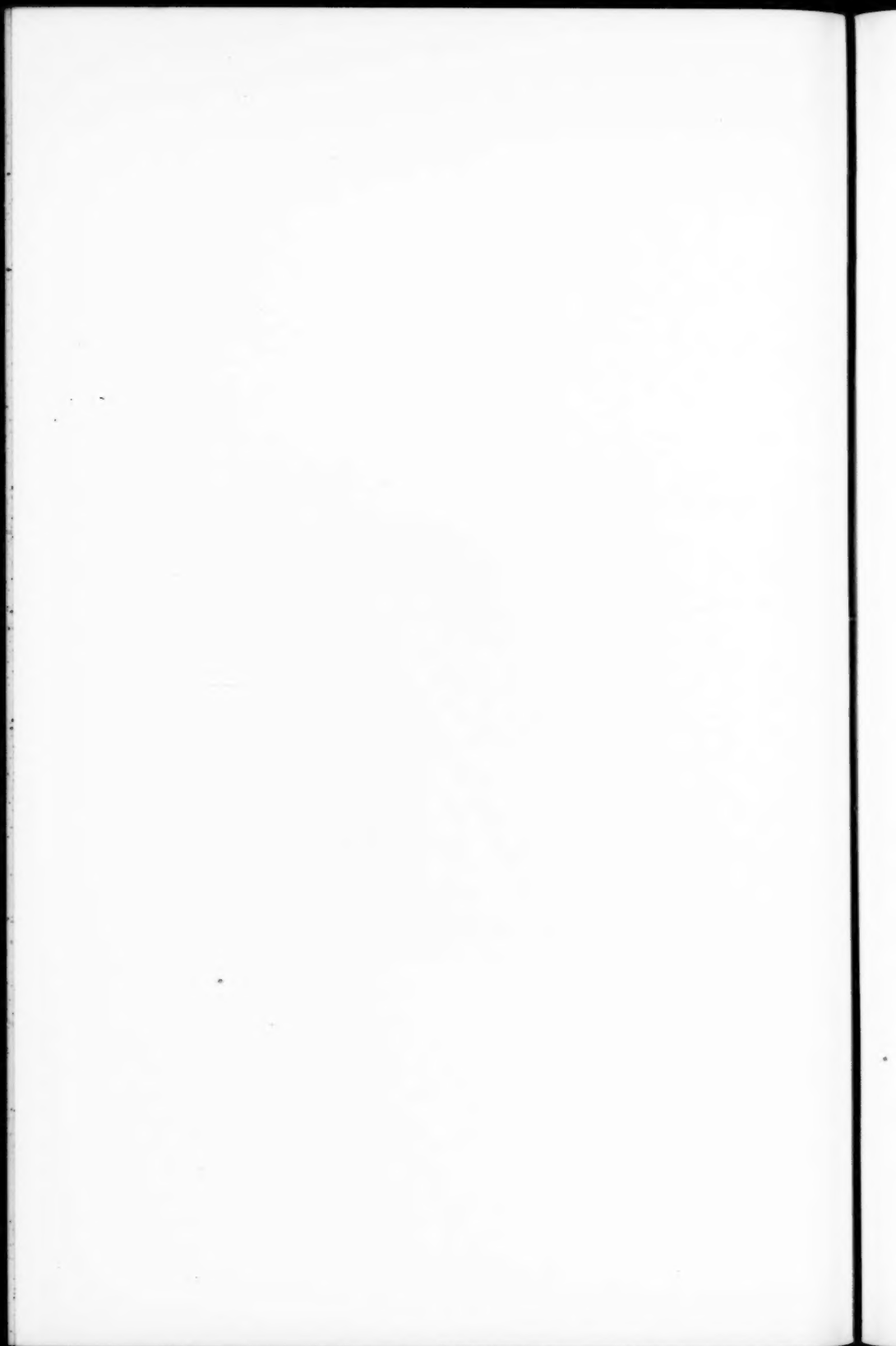












XIV.

COMPENSATORY NASAL GROWTHS.*

By J. A. PRATT, M. D., F. A. C. S.,

INSTRUCTOR OF OPHTHALMOLOGY AND OTOLARYNGOLOGY,
MEDICAL SCHOOL, UNIVERSITY OF MINNESOTA,

MINNEAPOLIS.

Since 1910, I have advocated conservation of the turbinates. Up to the present time men are still removing turbinates for nasal stenosis, instead of doing a submucous resection of the septum.

While we can excuse those who read little and never attend medical meetings, we cannot excuse men who pretend to be progressive.

I think I could safely say that at present there are now no nasal surgeons or men who pretend to do nasal surgery, who remove all of the lower turbinate. Those who have, in the past, removed part of the lower turbinate to make a larger opening into the antrum when the trocar washings have not cured the case, are finding they can perform this operation and still retain the lower turbinate.

In the past nasal surgeons have found it necessary to remove a part or all of the middle turbinate in order to exenterate the anterior or posterior ethmoids or open the frontal sinus intranasally.

For many years I have been performing an operation for exenterating the anterior and posterior ethmoids, opening the frontal sinuses or removing the anterior wall of the sphenoid intranasally, without removing any part of the middle turbinate. This operation was first presented to the American Academy at Cleveland in 1919.

*Read before the North Dakota Academy of Ophthalmology and Otolaryngology at Jamestown, North Dakota, June 1, 1922.

For some time I have observed soft meaty growths, of a hyperplastic nature but looking very much like turbinal tissue, growing out from the lateral wall of the nasal cavity or from the septum.

It was not for some months after first noticing these growths that they were associated in my mind with a roomy nose. The position of these growths with the physiologic protection they would give to the nose demonstrate their compensatory character.

These compensatory growths are found on the septum at about the position of the septum tubercle, and they are undoubtedly a hyperplasia of that tissue.

The anterior lateral wall growths are not anterior to the posterior edge of the nasal process of the maxillary bone but begin at the anterior attachment of the middle turbinate, following the anterior edge of the uncinate process, and seem to be a hyperplasia of the soft tissues of the uncinate process.

In this position they protect the frontal sinus opening, the infundibular and bullar regions, which are normally covered by the middle turbinate.

The posterior growths on the lateral wall develop along the posterior half of the attachment of the middle turbinate and protect the posterior ethmoids and sphenoids from irritating air currents.

One of the first cases to attract my attention was a patient, female, age 45, who had entered at the university dispensary. While the membrane of the nose looked healthy and there was no discharge, the nasal cavity was extremely roomy, the turbinates were rudimentary in form, and the nose had the appearance of having had all the turbinates removed.

In the front half of the nasal cavity, beginning at about the anterior attachment of the middle turbinate and extending downward to a little below the attachment of the lower turbinates, was a large, thick, meaty growth, extending nearly to the septum. The growth was present on both sides and re-

sembled, in a crude way, the anterior end of the middle turbinate.

The patient gave a history of a very severe case of atrophic rhinitis, with the formation of enormous crusts all during her girlhood, but now she was free of all nasal trouble.

After satisfying myself that the growths were compensatory, I called one of my fellowship men, with whom I had discussed compensatory growths of the turbinates and ethmoids, and without suggestive assistance he named the growths compensatory.

Since having our attention fixed on these growths we have found them in many cases where the middle turbinates have been removed for exenteration of the ethmoids. What a lesson nature has given us against mutilation of the turbinates. If all other arguments were forgotten, this would prove the case.

In some cases where we have a large nasal space, due to a deflected septum, where the middle turbinate and the ethmoid capsule are compensatorily hypertrophied and we have a suppurating frontal sinus present, I have seen the irritating discharge cause an anterior growth to develop, giving the appearance of a double middle turbinate. Upon examination the growth will be found to spring from the lateral wall, in the position of the anterior compensatory growth, showing they grow from irritation.

The first opportunity I have had to register any definite date as to how long a time it takes for these compensatory growths to develop was afforded me on Saturday, May 6, 1922.

The patient came for an acute exacerbation of a chronic frontal sinusitis. Two years before one of our well known specialists, a man with whom I was in Vienna in 1904, removed the anterior half of her middle turbinate for sinus trouble.

The patient had a perfectly marked compensatory growth, which could easily be confused as the anterior end of a middle turbinate. The growth was allowed to remain in place and

the frontal sinus opened just back of it, in the normal position. This places the development of the growths within two years.

Many men may have noticed these growths and appreciated their significance, but they have not reported them, as far as I know.

With the prevalence, in the past, of the removal of turbinate, I am sure, with a little care and time, we can all see these compensatory growths.

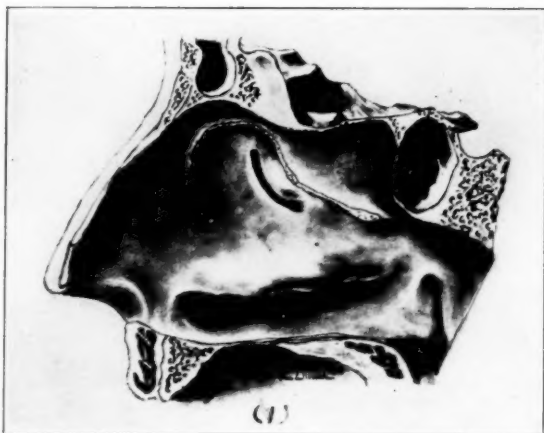
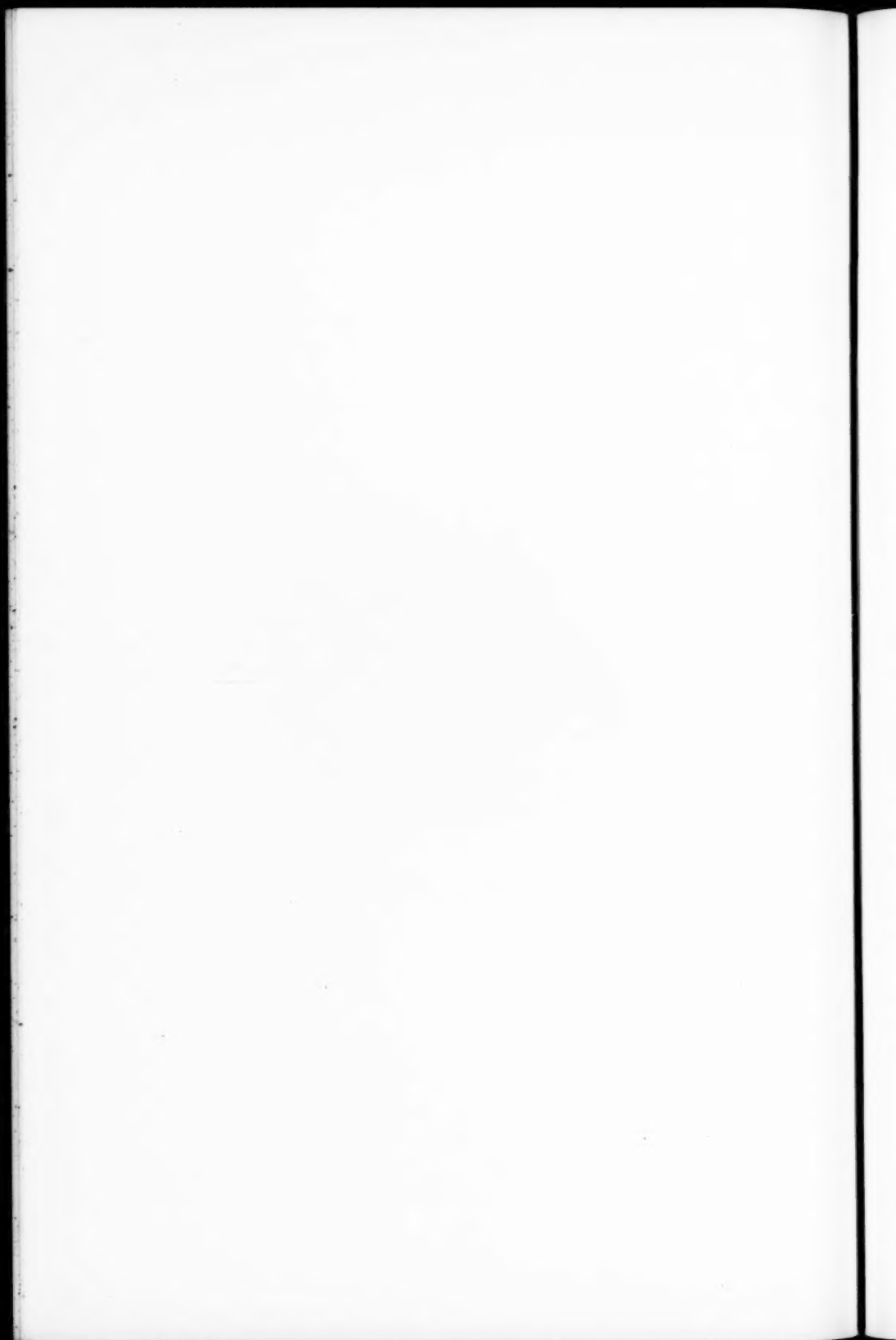


Figure No. 1. Showing a normal lateral wall with the middle turbinate removed. This gives a relative idea of the position of the compensatory growths shown in Figure No. 2.



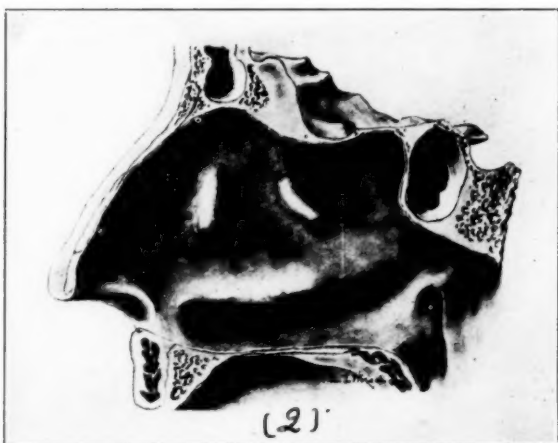
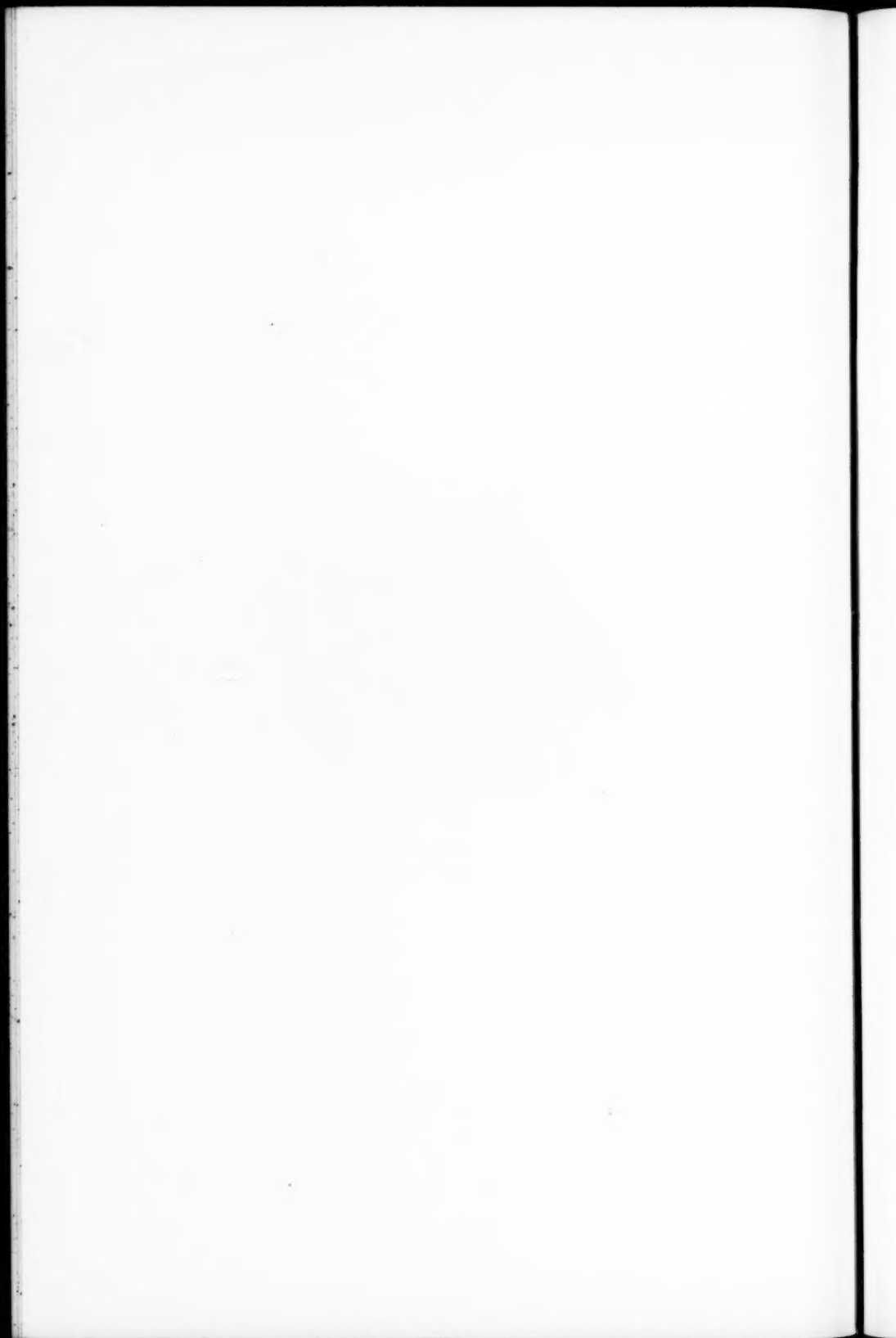


Figure No. 2. Position of the compensatory growth on the lateral wall. Other landmarks of the lateral wall have been effaced to clearly show the position of these growths.



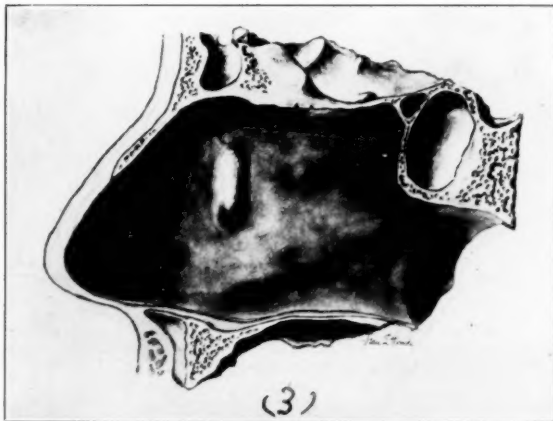
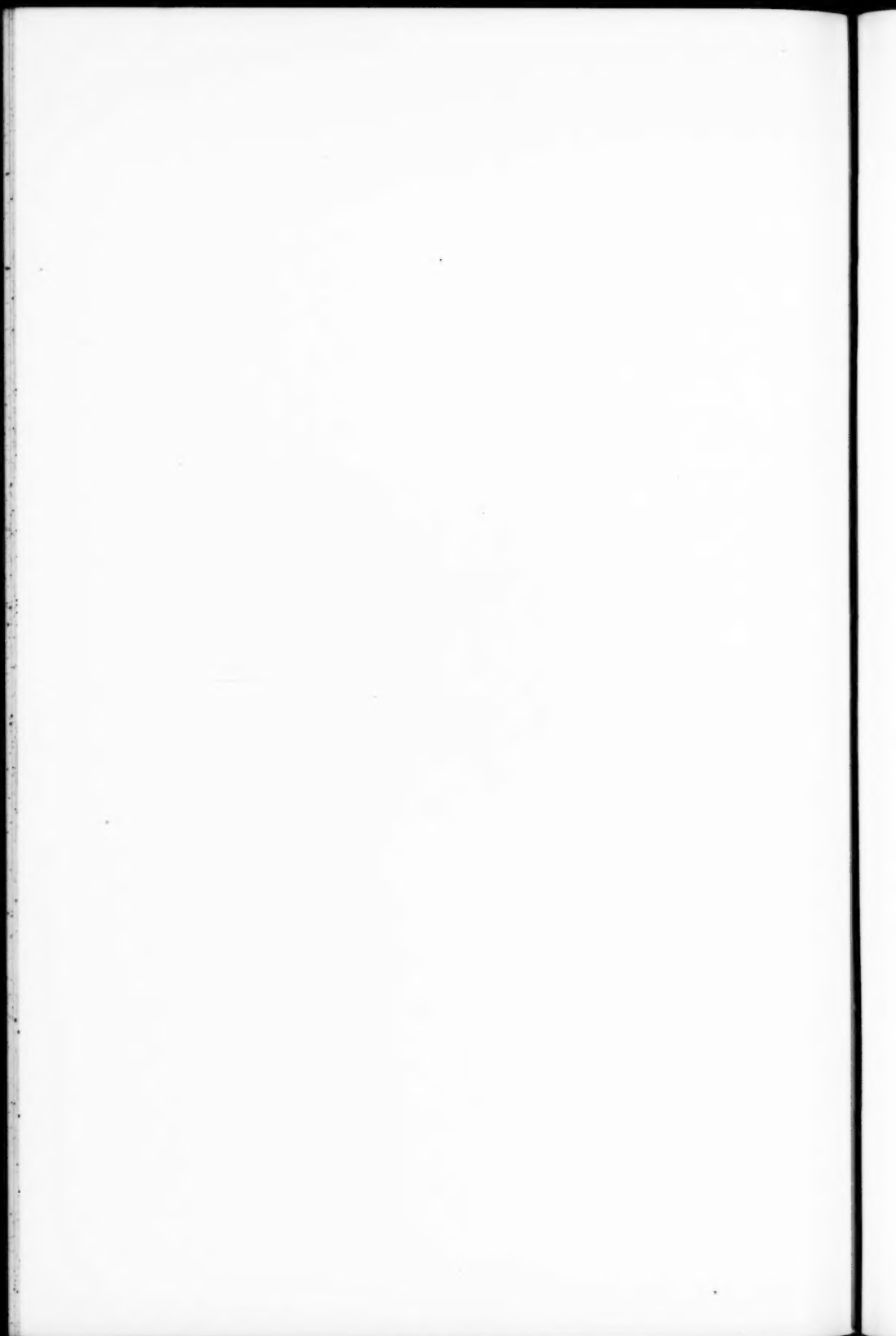


Figure No. 3. The position of the compensatory growth on the septum when it is present.



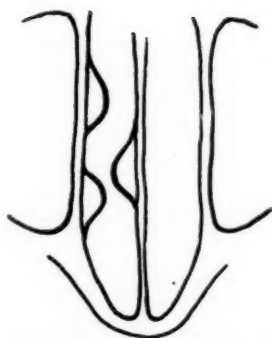
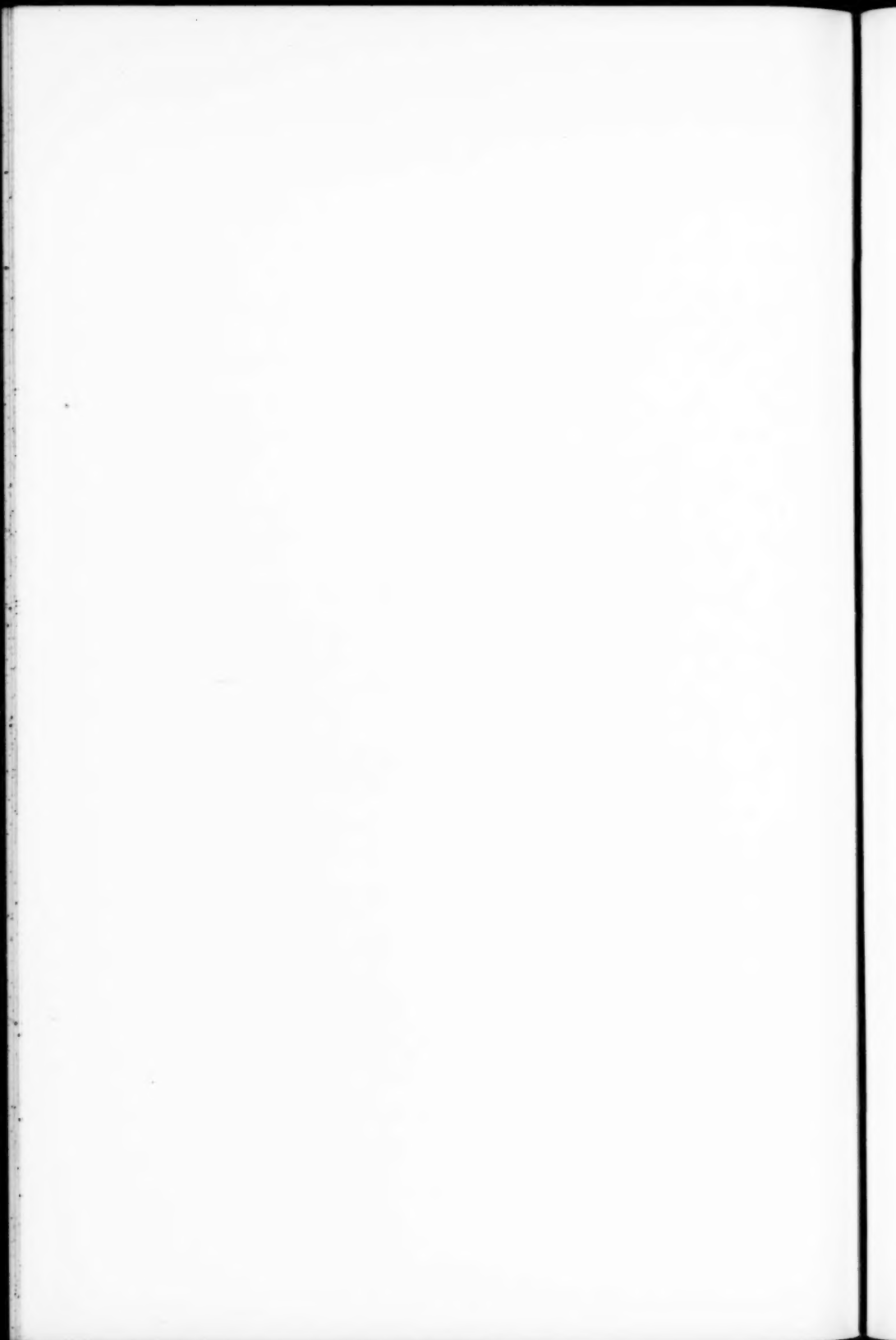


Figure No. 4. A diagrammatic horizontal cut through the nasal chamber showing the relative position of these compensatory growths and how they compensate for the loss of the turbinates.



XV.

REPORT OF A CASE OF TONSILLAR CYST WHICH PROTRUDED FROM THE TONSIL AS A PEDUNCULATED TUMOR.

BY ARTHUR W. PROETZ, M. D.,

ST. LOUIS.

Mrs. X, white, aged about 28, applied at Washington University Dispensary, complaining of a mass in the throat which interfered with swallowing. The mass was of slow growth and was not painful.

Examination showed a pedunculated tumor about the size of the tonsil, lying mesial to it, against the posterior wall of the pharynx. The surface was irregular and somewhat resembled a papilloma. On first examination it appeared to be attached to the posterior pillar, but closer inspection showed the attachment to be at the superior pole of the tonsil. The remainder of the pharynx was negative. The tonsil with the mass attached was removed by Dr. W. M. C. Bryan. The patient made an uneventful recovery.

The specimen on examination shows the tumor mass and the tonsil of equal size and bound together at the superior pole by an attachment 6 mm. in diameter, the tumor having about the same firm consistency as the tonsil. A section was made at right angles to the long axis of the tonsil and tumor, through the pedicle. Much to our surprise the mass proved to be a lacunar retention cyst.

The occluded crypt, which can be traced to the capsule of the tonsil, was firmly sealed by some former acute inflammatory process. As the retained detritus increased in bulk, the tonsil tissue which covered it was forced out and mucous membrane and submucosa proliferated, while the lymph follicles, caught between the wall and the advancing cyst, were all but destroyed.

The tumor was covered with mucous membrane only slightly thicker than normal. The cyst wall was composed of thick

connective tissue in which the follicles were to be found at intervals. The cyst was lined with low columnar epithelium, which in places appeared to undergo pressure atrophy. The wall varied in thickness from .5 mm to 2 mm. Portions of this wall were composed of approximately normal tonsil tissue, while other portions showed local chronic inflammatory changes, thick strata of loose connective tissue and some solid masses of fibrous tissue.

The writer has been unable to discover in the literature any record of tonsil cysts lying without the body of the tonsil. Ballenger, under the heading "Cystoma," dismisses the subject with the statement that cystoma of the tonsil is rare, that it may be either superficial or deep, varies in size, and may contain a quantity of fluid or a mass of inspissated secretions and epithelial debris.

Harry A. Barnes in his *Monograph on the Tonsils* (Mosby, 1914) says: "Cyst of the tonsil results from an inflammatory occlusion of the mouth of the crypt, and the subsequent dilatation of the resultant blind sac by the accumulation of cheesy detritus. It may be situated anywhere in the tonsil, and when small is easily confounded with chronic abscess. Cysts occasionally attain great size. One that I removed seemed to have absorbed the whole tonsil."

Phillips says: "Tonsillar cysts usually result from the inflammatory closure of the lacunar mouths, beneath which collections of caseous matter become encysted. They are also believed to result from traumatism and from the use of the galvanocautery."

This case, while presenting nothing new from the standpoint of pathology, is nevertheless unusual and interesting from a diagnostic angle.

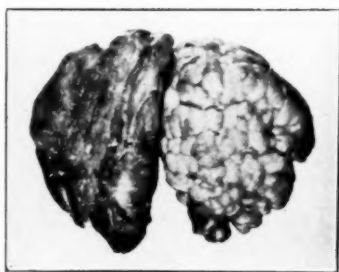


Fig. 1.
Tumor attached to tonsil.

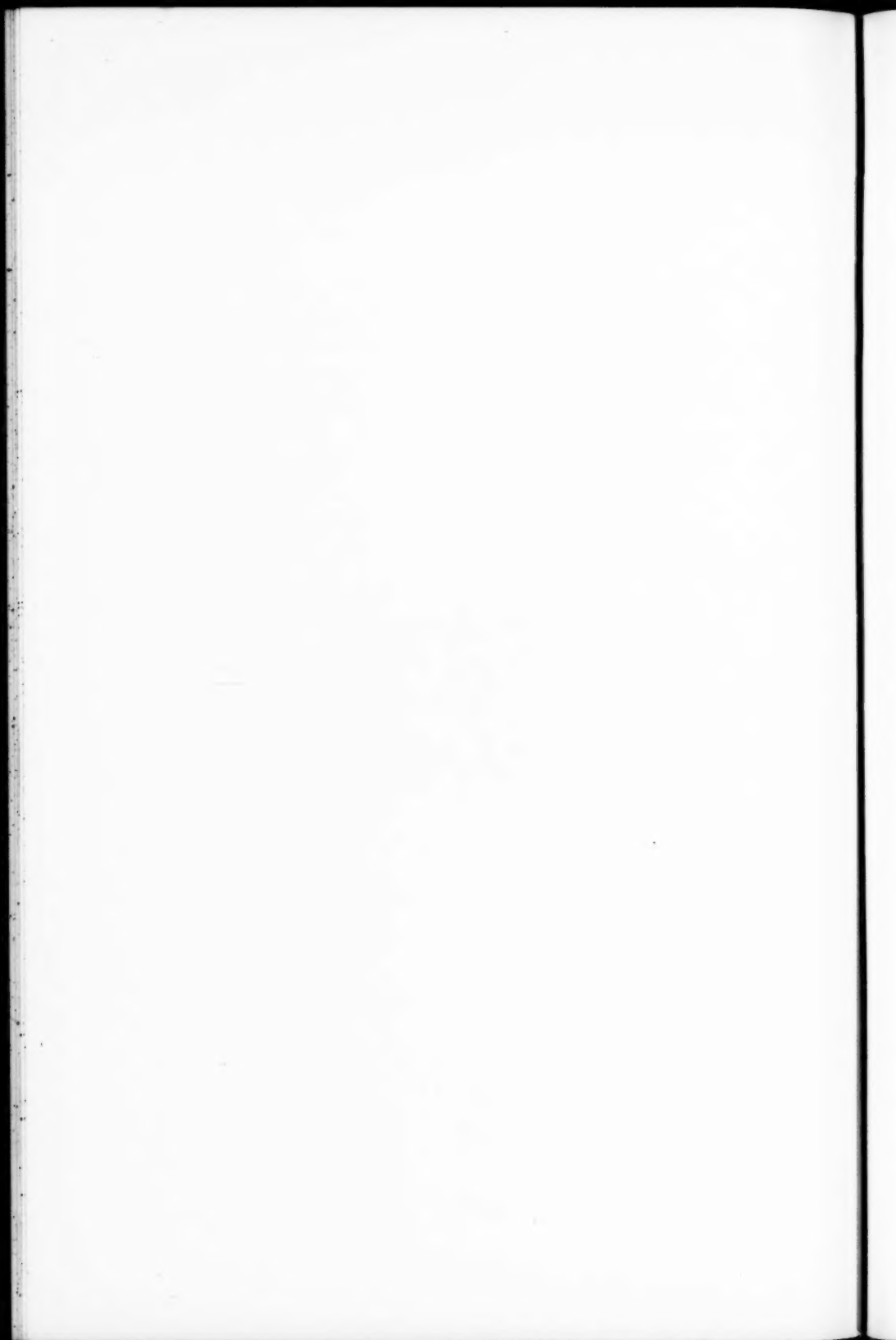
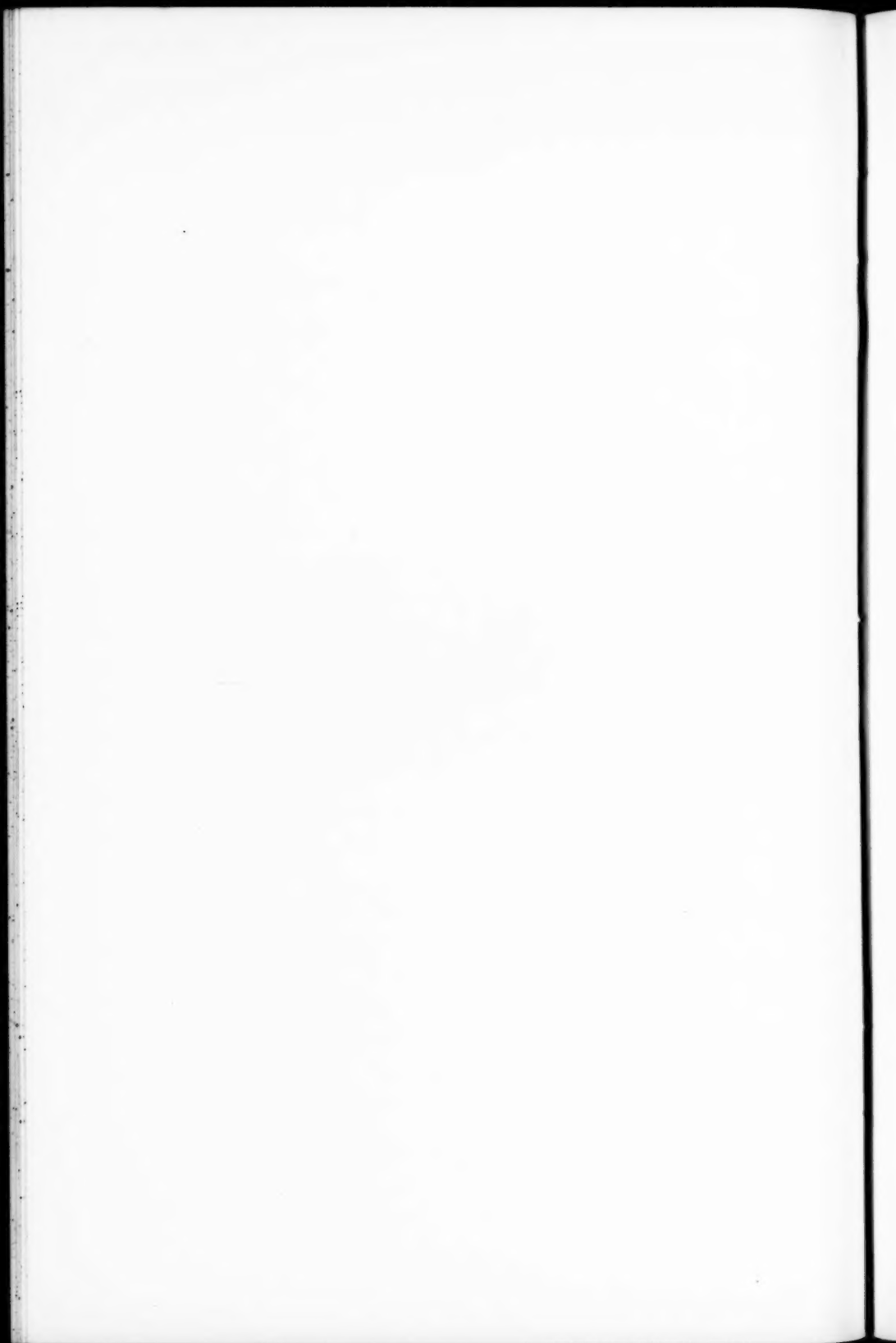




Fig. 2.
Cross section through the pedicle.



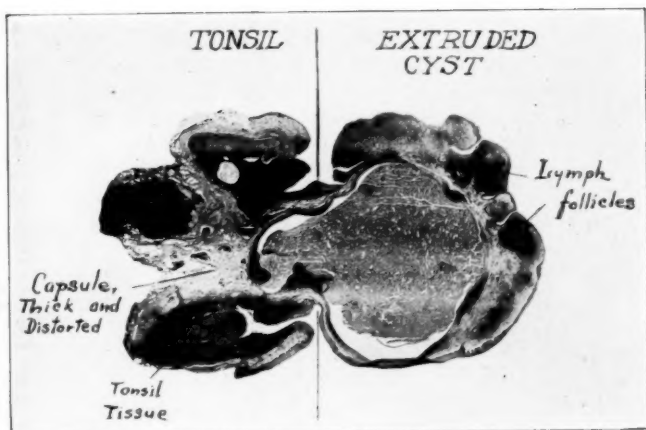
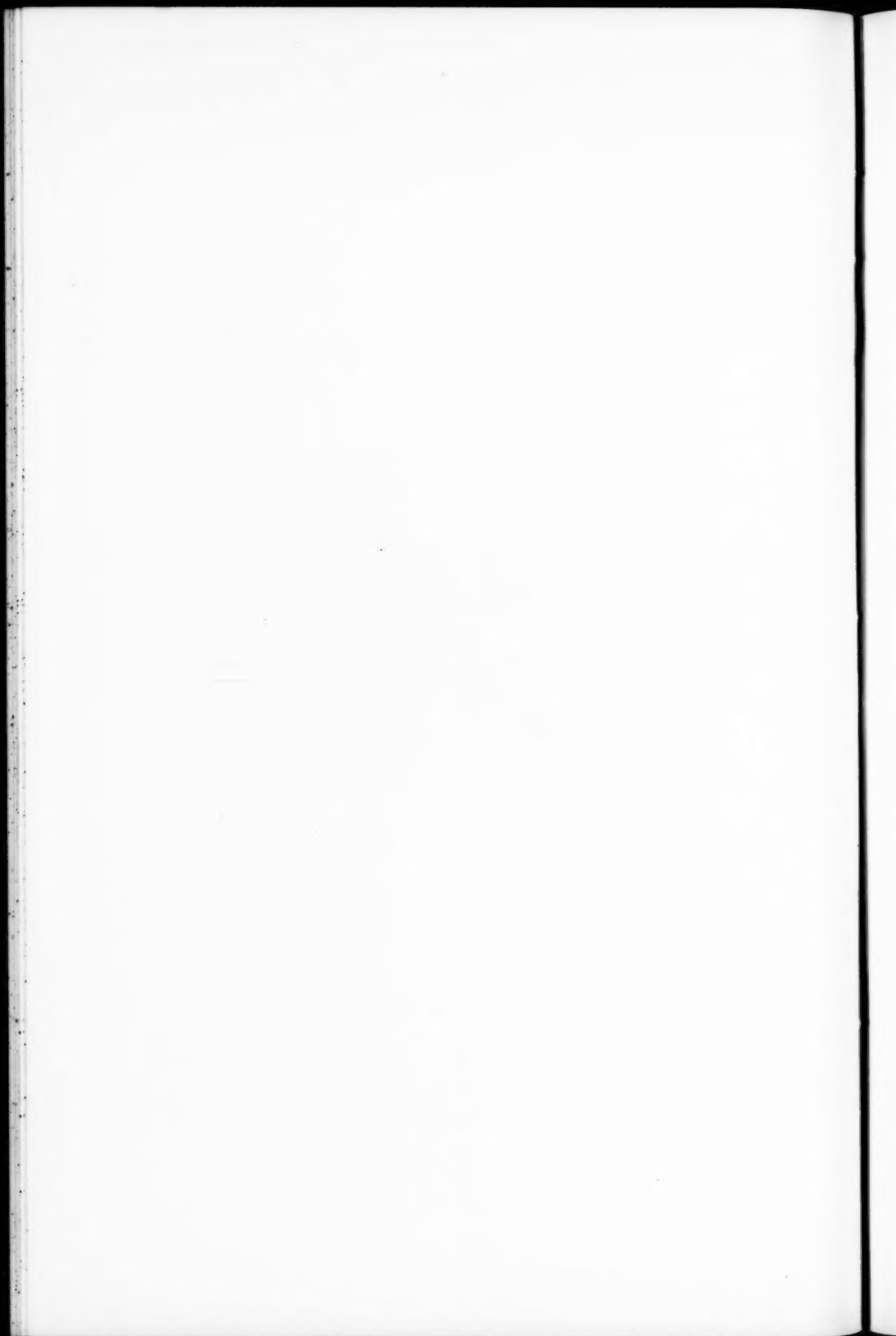


Fig. 3.
Section through the pedicle.



XVI.

REPORT OF A CASE OF CODEIN POISONING.

BY ARTHUR W. PROETZ, M. D.,

ST. LOUIS.

On June 23, 1920, patient Miss L. B., clerk, age 28, presented herself for treatment. She complained of a dry non-productive cough which had persisted for two weeks. It was apparently not preceded by any acute infectious process, there having been no sore throat, no influenza, or any other systemic disease which might have accounted for the symptoms. Nasal examination was negative, submucous resection having been performed the year before. The pharynx was mildly congested, larynx and trachea were not involved. The diagnosis lay between habit cough and irritation by a slightly elongated uvula. While observing the case the patient was given a prescription for elixir terpine hydrate with codein (N. F.), in which the codein content is one grain to the ounce. Dose: One teaspoonful every three hours.

After taking three consecutive doses (about one-half grain of codein) the patient complained of lassitude, some nausea, cold and clammy skin, and general apathy. The mixture was discontinued and the following day the patient felt quite well. The cough subsided after a few days under local treatment.

The cause for the patient's indisposition was not determined at the time, and the codein was not suspected until January, 1922, when the patient appeared on a Sunday afternoon complaining of severe toothache. She was unable to find her dentist at that time and asked for something to relieve her pain. As a temporary measure she was given a prescription for codein sulphate, one grain, to be mixed with milk sugar and divided into three capsules. She took one of these capsules and within half an hour exhibited the same symptoms as before: great languor, pallor, increase in pulse rate to 90, skin cold and clammy. It was only then that the similarity of the symptoms to those of the previous attack was noted and

the cause laid to the codein. The patient has never had similar attacks before nor since. In each case the dose was, if anything, less than average.

Wood in his work on therapeutics outlines practically the symptoms given as the result of codein poisoning. He adds that "In S. Weir Mitchell's experiments upon himself five grains produced no symptoms except slight increase in the pulse rate, nausea, some giddiness and a sense of heaviness about the head; results which are in accord with the earlier experiments of Harley. Contrariwise, A. S. Myrtle records a case of severe poisoning caused by four grains of codein. There was first vascular excitement and exhilaration, then depression with great anxiety, nausea and vomiting, pale, cool, clammy skin, slight contraction of pupil and sleeplessness, with slight delirium. Two cases of serious poisoning by eight grains have been reported."

Toxic effects following small doses of codein, although unusual, should be borne in mind, as they may readily be confounded with symptoms of influenza or the toxemias associated with other infections of the upper respiratory tract. In the above case it was only the patient's freedom from any acute infections which fastened the attention upon the codein as the cause of the trouble.

XVII.

REPORT OF TWO CASES OF SALIVARY CALCULUS.

BY ARTHUR W. PROETZ, M. D.,

ST. LOUIS.

Case No. 1.—Miss J. B., a nurse, 24 years old, applied April 20, 1920, for relief from a large but only moderately painful swelling in the right submaxillary triangle of the neck. This swelling appeared quite suddenly during the night, and by the following noon filled the entire triangle, with considerable bulging. The patient had had no symptoms at any time previously and thought she had the mumps. The orifice of Wharton's duct was more prominent on the affected side, but not red. At short intervals small drops of thick, viscous saliva escaped from it. Palpation disclosed an indefinite mass quite far back in the duct. With a small bistoury the duct was slit for about an inch without encountering obstruction. On probing further with a whalebone filiform the stone was encountered and pressure upon it with the bougie, causing a backward dislodgement, produced a copious flow of thick saliva. The tube was slit still farther and a large calculus found, lying in a fusiform sack or dilatation of the duct, which was slightly longer than the stone and in which the latter slid back and forth fairly freely. It was removed without difficulty, the wound healed rapidly, and at the end of a year no signs of any further trouble had developed. This stone measured 11.9 mm. by 8.5 mm. by 5.4 mm. and presented a longitudinal crease or slit which permitted the saliva to pass. See figure.

Case No. 2.—The patient, Miss K. G., aged 14 years, first seen September 6, 1921, complained of deafness of variable intensity for four years, high pitched tinnitus and frequent sore throat, although two tonsillotomies had been done. History of discharging ears at some previous time. Measles at six, no other illnesses. The patient was an extremely refractory child. She had not been living for some years with her mother, who brought her, so that an accurate history was not

available. The data germane to this report, however, were as follows: There was swelling with extreme pain in the region of the right submaxillary gland. This pain had persisted for three to four weeks, becoming excruciating at times, especially during meals. Wharton's duct was thickened and palpable throughout its length. The papilla on the infected side was red and swollen. On palpating the duct a small quantity of ropy saliva containing pus appeared at the papilla. The duct was slit and a quantity of thick, viscous material was liberated. There was a mixed infection, principally staphylococcus. No calculus could be made out at this examination. The patient was seen daily and, as the pain continued with periodic evacuations of purulent saliva, further search for calculus was made six days later. The whalebone filiform encountered a small stone no larger than a coarse grain of sand, which was removed. This granule was unfortunately lost.

Following this, the pain and infection cleared up promptly and remained so three weeks later, when the patient was lost sight of.

These two cases are reported because in each the intensity of symptoms was out of proportion to the size of the offending calculus.

The calculus in the first case was among the largest on record, and had caused no symptoms up to the night preceding its removal. This was probably due to the sulcus which traversed one side of it in a longitudinal direction and permitted the saliva to pass. The second calculus, a mere grain of sand, caused excruciating pain for weeks preceding its removal, and two teeth were sacrificed through the efforts of a dentist to overcome the trouble. In this case there was infection present. The patient's mouth had been badly neglected. There were several carious teeth and heavy deposits of salivary calculus at the gingival margins. The first patient's mouth was in excellent condition.

In the cases reported in the literature, of which about 300 have been collected, pain was the outstanding symptom. The "colique salivaire" is frequently described as an intense, sharp pain on the floor of the mouth, the tongue and the side of the neck.

Erdman reports a case in which an attack occurred four years before the removal of the calculus, with a pain-free interval and recurrence eleven days before operation. With the observation in mind that a mere grain of sand may cause severe symptoms of obstruction, the possibility of spontaneous delivery presents itself, especially in cases of long intervals between attacks. The presence of salivary calculi should be carefully ruled out before teeth are sacrificed in an endeavor to reduce submaxillary swelling.

XVIII.

TRAUMATIC FACIAL DIPLEGIA, WITH INVOLVEMENT OF THE SIXTH NERVES, A PORTION OF THE LEFT THIRD NERVE, ALSO THE FIFTH AND EIGHTH NERVES, WITH DISLOCATION OF THE ATLAS, ETC.*

BY GEORGE F. KEIPER, A. M., M. D.,

LAFAYETTE, INDIANA.

Traumatic facial diplegia is apparently a very rare condition. The great war produced but very few cases. A survey of the literature of this subject for the last thirty-five years, made with the help of the librarian of the office of the Surgeon General of the United States Army, has brought to light the few cases on record, none of which parallel in all respects the description of the case which it is my privilege to present to you today, a case which is of interest to the ophthalmologist, otolaryngologist, neurologist and general surgeon alike.

Bilateral facial palsy may be due to a variety of other causes. Patrick gathered together forty-eight cases due to multiple neuritis. Ross found five due to diphtheria and five due to influenza. It may be due to double otitis media and mastoiditis. Throckmorton reported a case due to rheumatism, wherein an interval of a week elapsed before the other side of the face became involved. Sir Charles Bell reported a case due to syphilis.

But the cases due to traumatism are indeed very rare.

Ransohoff, in a communication to the 1919 meeting of the American Surgical Society, could find but four other cases in the literature than his own and appended one with Sach's permission hitherto unreported. He failed to note the earliest case reported by our own lamented confrere, Alvin W. Hubbell of Buffalo. In giving a resumé of the cases reported to

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date I quote liberally and literally from the writing of the reporters.

The first case to be reported, as far as we can find, as intimated above, was in 1889 by Hubbell: Henry M., aged 23, a switchman, while coupling cars, August 21, 1888, had his head caught between the projecting ends of the loaded lumber on two cars, between which he stood at the time. He was picked up unconscious and hurried to the hospital. Hemorrhage poured profusely from both ears, nose and mouth. He vomited blood frequently. Pulse was 54. Diagnosis was given as fracture of the base of the skull. On the following morning he was in a semiconscious state. On recovering consciousness it was found that the hearing of both sides was somewhat impaired. Complete facial paralysis of both sides of the face was noted. The patient was unable to close the eyelids or to move the lips. His face was absolutely expressionless. Both right and left abducens were completely paralyzed, resulting in a marked convergent squint of both eyes. The pupil of the right eye was dilated and its accommodation impaired. The right side of the tongue was dry and rough, with a total loss of the sense of taste. Deglutition was difficult. Sensation and motion in other parts of the body were normal. He had intense pain in the forehead. He gradually improved and his sense of taste returned after a month. The sight and hearing returned to normal. The pupil contracted down.

The reporter on July 2, 1889, stated that the facial paralysis had so far improved that he could nearly close his eyelids and in laughter could move some of the muscles of the mouth. The left abducens had nearly recovered its function. The right abducens was still paralyzed.

For the following four cases I am indebted to Ransohoff in the article mentioned above:

Case 1 (Koslovsky).—Private J. J., white, while carrying logs from a boat to a landing fell in the water, a distance of ten feet, and was struck by a log over the left side of the head. When brought to the hospital he was bleeding from both ears and nose and was vomiting. Consciousness was retained but speech was very indistinct. There was a large hematoma on the left side of the scalp. No other external injuries. He had considerable headache. Temperature was normal, likewise the

pulse. The pupils refused to respond normally to light and shade, but later the pupil became normal in the right eye. The left pupil was dilated and did not respond to light. There was constant and marked diplopia. Hearing was much lessened on the right and entirely lost on the left side. The tuning fork could not be heard on this side. There was complete paralysis of both sides of the face.

All the symptoms detailed above appeared simultaneously. After three months the paralysis of the face continued unchanged. The patient remained completely deaf in the left ear, while the hearing in the right ear was somewhat improved. The sense of taste was at no time affected. When the patient was last seen it seemed that the condition detailed at the last examination would be permanent.

Although there was no X-ray confirmation, the diagnosis of basal fracture could not be questioned. The injury to the facial nerves must have been above the geniculate ganglion, from the undisturbed taste function. It is probable that from the involvement of the other cranial nerves the tear was above the entrance of the nerves into the internal auditory meatus of each side.

Case 2 (Oppenheim and Hallez).—P. J., age 28, infantryman, was injured October 27, 1916, by the bursting of a shell in close proximity. There was immediately loss of consciousness, followed by prolonged anorexia. He could furnish no details as to how he was hurt. Consciousness returned sixteen hours later. The primary reports state that there were no external lesions. Double facial paralysis, bleeding from both ears, profuse nose bleed and slight mydriasis on the left side were all apparent. After a day or two he became semi-conscious again, and when he recovered he complained greatly of nausea and vertigo. Epistaxis and bleeding from one ear returned again. He entered the otologic service two weeks after his injury for "concussion of the labyrinth, injury to the tympana, with infection on both sides, and facial diplegia."

The face presented the appearance of a blank mask, without any expression, the creases of the forehead and the face having completely disappeared, and there was slight edema of the face in both cheeks. There was no diplopia and visual acuity was normal. Speech was a little slow, scanning and especially

embarrassed by the pronunciation of the labials. Deglutition was normal.

It is interesting to note that after the first visit of the patient's wife, in consequence of a violent emotion the man presented a complete mutism for four days.

The cheeks were flabby, mastication was considerably embarrassed, because foodstuffs fell between the gums and the cheeks.

The soft palate was lifted normally, and there was no deflection of the uvula. The sensibility of the tongue was conserved, but the sense of taste was abolished in the anterior two-thirds.

The electrical examination, made in January, two months after the injury, showed a degeneration reaction of the seventh pair a little more marked on the right than on the left side. The hearing on the right was diminished and there was suppuration of the middle ear. On the left side the hearing was quite gone and there was suppuration of the middle ear. The facial and auditory nerves seem therefore to have been involved, but no others were in any way injured.

The lumbar puncture made in January gave a clear lymphoid fluid with a little more albumin than normal and a scarcely appreciable increase of the cellular contents.

The lesion doubtless therefore was in the fallopian canal on each side. After several months' sojourn in the service the patient improved considerably, the eyelids could be partly closed and the forehead could be slightly furrowed. As to the course of the paralysis the authors are in doubt. It might have resulted from a fracture through the petrous portions of both temporal bones, or again it might have resulted from an immediate extratubal concussion. It is also possible that the injured man was thrown backward and sustained a fracture of the base through both temporal bones. In favor of this hypothesis are the nose bleed, the repeated bleedings from the ears and the prolonged coma. In support of the possibility of the shock of the explosion alone causing the damage in the petrous portion of the temporal bones without fracture, the authors allude to two men who, without any trace of external injury or even of a fall, presented simply as a result of the concussion, a total unilateral facial palsy.

Case 3 (Chatelin and Patrikos).—The case when presented was of six weeks' duration. There was a double paralysis of the peripheral type. On the left side the paralysis was absolute, while on the right side there was an indication of very slight movement in an effort to close the eye. The aspect of the face was characteristic. The forehead was entirely without wrinkles, the nasolabial folds had disappeared, the lips were half open and the saliva drooled from the mouth. Speech was almost incomprehensible. Mastication was difficult. Electrical examination showed complete degeneration reaction on both sides. The diplegia was the result of an accident. The wounded man was about to unload a heavily loaded wagon, when it was suddenly propelled backward and his head was caught transversely between the wagon and the wall. Released at once, the man bled from the left ear. The diplegia manifested itself at once. For several days the face was very much swollen and he had many ecchymoses in the temporomalar region. Eating was uncomfortable on account of the trismus. This, however, disappeared in a few days. The writer believes that the facial nerves were injured on both sides by a transverse fracture at the base of the skull, even if there were actual symptoms of injured lesions of the organ of audition. It appears to the writer that the absence of the loss of taste and of the radiographic evidence of fracture of the base in this case, it is more likely that underneath the ecchymoses described in the temporomalar region the facial nerves had been injured by compression after their exit from the stylomastoid foramina.

Case 4 (Marchand).—Soldier, aet. 22, was thrown from an automobile truck August 22, 1917. He had no recollection how the accident happened. There was immediate bleeding from the ears, with epistaxis and bilateral facial paralysis. In the temporal region there was a contused wound. The patient was unconscious for forty-eight hours.

Diagnosis: Fracture at the base of the skull.

On the morning following admission there was considerable palpebral and subconjunctival hematoma. There was also hematoma at the nape of the neck. A lumbar puncture was made on the day of the accident, but in the original report no

result of the examination was given. During six days the punctures were repeated.

He was admitted to the neurologic center at Bordeaux, on December 4, 1917, when the facial paralysis continued. The record states that the movements of the face are nil on both sides. The patient cannot laugh, cry or whistle. Speech is difficult on account of the inability to pronounce the letters P, B and M. Swallowing is normal, but to drink the patient must hold his head backward to prevent liquids from running out of his mouth. The sense of pain and touch is normal, both in the tongue and in the face. Salt, acids or sweets are not felt on the anterior two-thirds of the tongue on the right side, but the taste for bitter things is normal on both sides. In March, 1918, there was some voluntary movement of the lower portion of the left side and the left eye could be completely closed. There was still a loss of the gustatory sense of the left side. On the right side the paralysis presented improvement.

Case 5 (Ransohoff's own).—Miss E. K., aet. 22, was injured January 4, 1919, in a street car accident. She bled from both ears and was unconscious when admitted to the Cincinnati General Hospital. She was in coma for one hour. Vomiting followed. Then two general convulsions followed, lasting for five minutes. Patient suffered from severe headaches with pain in the ear. She had nausea for ten days. The pulse and temperature were normal. Complete left side paralysis was present with slight ecchymosis over both mastoids.

On the morning of the third day after admission the right side of the face became completely paralyzed. She was mentally sluggish. The right pupil was larger than the left. The left external rectus muscle was weak. The other eye muscles were normal. The patient was unable to close either eye or to move the wings of the nose or the lips. The face was mask-like. The lips flapped loosely on expiration. Speech was very indistinct.

Dr. Iglaue examined the ears. The right ear showed slight tinnitus. The drums were intact. There was no spontaneous nystagmus. Weber was lateralized to the left. Bone conduction was normal. The whispered voice was heard at eight

feet. No hyperacusis was present. The eighth nerves were intact.

She could protrude her tongue in the midline and move it from side to side. The uvula hung in the midline. The sense of touch was normal. The sense of taste was absent on both sides of the tongue in its anterior two-thirds. She could not distinguish sweets, vinegar or bitter things.

The X-ray showed an oblique fracture through the cranial base running through the left mastoid process into the petrous portion of the temporal bone.

Paralysis disappeared from the right side of the face in two or three weeks, and during the next two months it disappeared entirely from the left side. Muscular control began in the lower portion of the face. The eyelids recovered last. Both sides recovered alike.

The lesion in Ransohoff's case was in each fallopian canal below the geniculate ganglion and at a point above the point where the chorda tympani is given off. It was also below the point where the nerve to the stapedius is given off, since there was no record of hyperacusis.

Ransohoff refers to the theory of Moure, that the facial nerve in the fallopian canal is composed of two sets of fibers: one peripheral or superficial, which supplies the lower facial group of muscles, and the central or deep, which innervates the upper muscular group. But there was never any anatomic demonstration of his theory, and the case of Ransohoff denies such an hypothesis.

Case 6 (Sachs).—Patient, aet. 16, admitted October 11, 1912, after a motorcycle accident. He was bleeding from the right ear and nose. No fracture could be made out by palpation. K. K. was negative. There was no ankle clonus and no Babinski reflex present. The left pupil was somewhat dilated. It did not respond to light. The left eye showed slight exophthalmos. Pulse was 138. Blood pressure was 135 mm. The vessels of the eye grounds were tortuous. Lumbar puncture could not be made. The right external rectus muscle was completely paralyzed and the left one slightly so. He could not pucker his lips or whistle. Neither facial nerve reacted to faradism. The strongest currents possible produced contractions, however. Quinin was not tasted in the anterior

portion of the tongue, but he did recognize it on the posterior portion of the tongue. Salt and sugar were recognized. When asleep both eyes closed, but when awake he could not close them. X-ray plates did not show basal fracture. On discharge October 11, it was noted that for the first time he was beginning to gain the use of the muscles about the mouth on the left side."

This completes the cases referred to in Ransohoff's paper.

Levy's and Tupper's Case.—Colored soldier, aet. 24, hurt June 9, 1919. His head was caught between two railroad cars. He was unconscious for three weeks. On August 23, 1919, he entered Cook County Hospital, Chicago. Examination revealed excellent mental and physical condition. No Romberg was present. There were no abnormalities in gait or in muscular, bone or genitourinary systems. No headache was present, neither dizziness nor gastrointestinal derangement. He could not pronounce labials.

The face was expressionless and the nasolabial folds were obliterated. The corners of the mouth hung down, especially the left. He could not wrinkle the forehead, pucker the lips, close the eyes or show his teeth. To drink he must roll up the lower lip and support it. The tongue was very dry and corrugated, but it could be protruded and moved in every direction. The uvula and soft palate were normal. The left eye showed marked paralysis of external movement. There was no nystagmus.

The sensation for taste, sour, sweet and salt, was lost over the anterior two-thirds of the tongue. The sensibility of the face and tongue was normal. All reflexes were normal save the corneal and conjunctival. Electrical examination showed degeneration of both seventh nerves and of the muscles supplied by them.

X-ray examination (Dr. Blaine) showed a shadow indicating fracture into the middle fossa of the skull close to the base and involving the right parietal temporal region.

Nystagmus tests: Rotation to the right produced no nystagmus. To the left, six seconds of nystagmus were produced, but to the right. There was no past pointing after rotation to the left. But after rotation to the right the patient past pointed two inches to the right with both hands. Hearing was

fairly good. On October 9, 1919, the right ear was douched with cold water, with no reactions from either horizontal or vertical canals. There was no past pointing, vertigo or nystagmus. Douching the left ear produced no response from the vertical canals. The horizontal canals gave slow nystagmus of fifteen seconds and past pointing to the left. On October 13, 1919, the vertical canals were stimulated by rotation and the reactions were normal but shortened. Stimulated by rotation to the right the horizontal canals gave nystagmus to the left, lasting for three seconds, and momentary past pointing with the left but not the right hand. Hearing was normal in the left ear, but somewhat diminished in the right ear. Bone conduction was normal on the left side but prolonged on the right side of the head. Conclusion: "The lesion of the vestibular apparatus is not due to a labyrinth destruction, is not peripheral."

Course: The right facial nerve, especially the lower branch, showed marked and progressive improvement, but the left facial nerve and the left abducens remained stationary at the time of the last examination.

Summary and Discussion.—1. There was bilateral degenerative facial paralysis of the peripheral type. 2. There was paralysis of the left abducens. 3. The chorda tympani was involved. 4. On the right side the hearing was impaired. 5. The lesion was one of the central portion of the vestibular apparatus.

The chorda tympani speaks for the involvement of both facial nerves in their fallopian canals—i. e., in the petrous portions of the temporal bones. But bilateral fractures of the pyramid bone is usually fatal (Marchand) and could not explain the involvement of the sixth nerve. We look for several or multiple lesions which are the rule in severe concussions of the brain. (Jacob.)

The writer's case:

Oscar Gustafson, Swede, aet. 34, was caught in a cave-in while laying sewer pipe in a deep trench. He was completely buried and when dug out was unconscious and bleeding from both ears and nose.

He regained consciousness in a few hours, and it was observed that his face was completely paralyzed. Complete internal squint of the left eye was present and partial of the right eye. He had diplopia. The record shows that he was very restless, complaining of severe pain in the head. The upper portion of the right chest was painful. At eight the night of the same day he was given 1,500 units of anti-tetanic serum.

His past history reveals nothing of the diseases of childhood, save measles. He had influenza two years before. Otherwise he has always been healthy. There is no history of lues and the Wassermann tests are negative. Neither tuberculosis nor insanity nor cancer affected any member of his family, past or present. His father died at the age of forty of pneumonia. His mother is living and well at the age of seventy-seven. One brother is living and well at the age of forty. Two sisters are living and well at the ages of forty-five and fifty, respectively.

Examination of his person: The right clavicle was fractured. Below the right ear was a perforating wound with partial separation of the auricle from the head. Bloody spinal fluid was obtained at a pressure of 150 mm.

The face was expressionless. He could not show his teeth nor whistle. He could not close his eyes. His speech was very indistinct because of the lack of lip action. Internal strabismus was very marked in both eyes. His tongue and lips were quite dry. He had trouble eating and drinking, because the food and drink would drop in between the cheeks and the jaws.

Sensation to touch and pain remained normal.

The thorax expanded fairly well and the breath sounds were of good quality and there were no rales or rales.

The left border of the heart was well within the nipple line. No murmurs, shocks or thrills were present.

The abdomen was slightly tender above the symphysis and there was no distension and no tumor masses could be made out.

The genitourinary apparatus was normal.

The skin was clear.

The joints were flexible.

The costochondral end of the right fourth rib was depressed and pressure caused pain.

There was no adenopathy.

The biceps, knee jerk and other reflexes were normal.

The pupils were equal and responded fairly well to light and shade.

X-ray examination revealed a dislocation of the atlas on the axis. Through the pedicle of the fourth cervical vertebra was an oblique fracture and a fracture of its spinous process.

The soft palate and uvula were normal. He could protrude his tongue and move it in every direction.

While the X-ray plate was not satisfactory, yet it seemed to show a fracture of the base of the skull passing through both temporal bones.

His temperature and pulse were as follows: July 5th—Temperature, 100.4°; pulse, 64. July 17th—Temperature, 97.6°; pulse, 50. July 19th—Temperature, 98°; pulse, 48. Otherwise both ran a normal course.

Both ears discharged pus freely.

On July 21st, on account of the eye condition, I was asked to take charge of the case by Dr. A. C. Arnett, his physician.

All the above conditions were present on that date, and in addition it was observed that the upper lid of the left eye drooped markedly. Both eyes have marked limitation of motion temporally.

Hearing tests were made. Weber was not lateralized. Rinne is negative. Right ear: Bone conduction, + 20 seconds, and air conduction, 14 seconds. Left ear: Bone conduction, + 25 seconds, and air conduction, 22 seconds. The tuning fork has 128 double vibrations per second and is weighted to guard against overtones. A stop watch was used as a timer.

Both membranæ were ruptured and pus was present in the lips of the wounds.

The pupils were normal and responded well to light and shade. The fundi appeared normal.

Protecting glasses with wire mesh temple guards were ordered to protect the eyes against extraneous substances of which the paralyzed eyelids could not dispose.

On July 21, 1921, tests of sensation were made with the esthesiometer with the following results:

	Right	Left
Supraorbital	6 mm.	9 mm.
Infraorbital	6 mm.	16 mm.
Upper lip.....	4 mm.	5½ mm.
Mental	7 mm.	10 mm.

The sense of smell seemed unimpaired.

The sense of taste was markedly impaired. He did not and does not recognize either quinin or vinegar placed anywhere on the tongue. Sugar and salt were barely recognized on the posterior portion of the tongue but not on its anterior portion.

On August 3rd he was allowed out of bed.

September 15th we made a record of his hearing as follows: Weber not lateralized. Rinne—Right ear, bone conduction, 25 seconds; air conduction, 32 seconds. Left ear, bone conduction, 32 seconds; air conduction, 28 seconds. Range of hearing, 128 d. v. s. to 38,000 d. v. s.

For the sake of comparison I will here insert the record of the last tests, made June 26, 1922:

Weber is now lateralized to the right. Rinne—Right ear, bone conduction, 22 seconds; air conduction, 51½ seconds. Left ear, bone conduction, 23 seconds; air conduction, 20 seconds. Low tones, 128 d. v. s. The upper limit is 40,000 d. v. s. Both ear drums are healed over.

Turning tests resulted thus: To the right ten times, nystagmus 20 seconds and of good amplitude. To the left ten times, nystagmus 19 seconds and of good amplitude. Falling tests are normal. He past points normally with both arms. No douching tests were made because of the condition of the ear drums. There were no fistula symptoms.

On September 15, 1921, the tests for sensation were repeated with the following results:

	Right	Left
Supraorbital foramen	8 mm.	10½ mm.
Infraorbital foramen.....	6½ mm.	9½ mm.
Mental foramen.....	5 mm.	14 mm.
Inframaxillary	15 mm.	18 mm.
Preauricular	11 mm.	12 mm.

The last tests were made August 3, 1922, as follows:

	Right	Left
Supraorbital foramen.....	9 mm.	10½ mm.
Infraorbital foramen.....	9 mm.	5½ mm.
Mental foramen.....	9 mm.	8 mm.
Tip of tongue	3 mm.	

The left eye gave us a great deal of trouble. Imperfect closure of the eyelids produced exposure keratitis. Iritis began to show itself August 18, 1921, with ulceration of the cornea, just below the center. Atropin and bandage with hot applications controlled the pathologic condition pretty well. Lugol's solution of iodine was also applied locally. By September 11th the healing was complete, with the usual scar. The ulcer recurred October 14th, and although the same treatment was pursued yet it progressed, and on October 26th we were compelled to raise a Kuhnt flap to prevent perforation of the cornea. The stitches pulled out on the 28th, but the ulcer had practically healed over. October 29th the cornea threatened perforation: Descemet's membrane only was intact. So another Kuhnt's flap was raised and the ulcer covered. On November 2nd, the stitches pulled out, but by the 7th the healing was practically complete.

Prince's method of pasteurization was tried, without avail, as well as thermophor of Shahan, likewise without results.

Inasmuch as others had made zinc fluorescin and mercury fluorescin (mercurochrome), not to be outdone I proceeded to make silver fluorescin by mixing a 2 per cent solution of silver nitrate with an equal quantity of the usual fluorescin used routinely in our offices to outline corneal ulcers. This was used to combat the intercedent suppuration, but it availed naught.

On December 23rd the ulcer recurred with rapid thinning of the corneal substance. We raised another Kuhnt flap from below again and covered the ulcer. It was effective in preventing perforation. But the ulcer did not heal in well this time, and again on January 4, 1922, we raised another Kuhnt flap because the ulcer threatened perforation. This was the last one needed, for the eye cleared promptly and the inflammation left it completely. Of course there is a large scar extending

up into the pupillary area, about one-half being occupied thus. Blood vessels can be seen coursing it from the limbus upward, nature's way of healing the ulcer.

Recession of the eyeballs into the orbit was noted in due time, and on November 29, 1921, I made measurements with the exophthalmometer of Hertel. The right eye measured 12 mm. and the left eye 11 mm. I checked this result with two normal individuals. One was the male attendant on the floor of St. Elizabeth Hospital, where our patient was confined, and the instrument measured 20 mm. for the right eye and 18 mm. for the left eye. Sister A.'s eyes showed 18 mm. for each eye. At the present the exophthalmometer measures 11 mm. for each eyeball.

The vision for the right eye, June 26, 1922, is 20/20, which is increased to 20/15 with a plus .50 cylinder axis 90 degrees. The vision of the left eye is 20/50 and no lens helps.

The blood examination was and is normal and so is the urine test.

The bacteria present in the conjunctival sac were the staphylococcus pyogenes albus and aureus and the micrococcus catarrhalis.

He is gradually improving and at the present his face is more mobile. He can now close his eyes pretty well. His speech is more distinct, as he has gained some control over his lips.

This patient was treated by an osteopath while under my care. That there may be no vainglorying, I had X-ray plates made September 1st, 1922. The dislocation of the atlas upon the axis still persists. Furthermore, a distinct line of separation of the parietal and occipital bones is apparent. The line of fracture into the petrous portion of the temporal bone still shows.

Observations in general as to this patient:

1. What is the meaning of the hemorrhage from the nose and ears?
2. What is the meaning of the ptosis of the left upper eyelid?
3. What is the meaning of the loss of hearing and its recovery in part?
4. What is the meaning of the double facial paralysis?

5. What is the meaning of the abducens paralysis?
6. What is the meaning of the reduced unilateral sensation?
7. What is the meaning of the apparent recession of the eyeballs into the orbit?

1. As he has survived, detailed examination of the cranium and its contents is impossible. But he suffered a fracture of the base of the skull involving, no doubt, the petrous portions of the temporal bones and probably the lesser wing of the sphenoid. The skull must have endured intense lateral pressure.

2. The ptosis of the left upper eyelid is hard to explain, because the section of the third nerve supplying the eyelid lies so far in advance of the other divisions of the nerve, as the lantern slide will show. Yet the median longitudinal fasciculus connects all the nerves involved.

3. As the static portion of the labyrinth was not involved, according to the tests applied, the cochlear portion was damaged somewhere between the internal auditory meatus and the origin of the nerves. However, this is pure speculation. The vestibular tests indicate that there was no involvement of the pons.

4. The double facial paralysis may be explained in a number of ways. It is probable that the basal fracture may have compressed both nerves in their fallopian canals. Or the corresponding hemorrhage compressing one nerve may have passed over from one nerve to the other, as the lantern slide will show. Again, the hemorrhage may have been in the nuclei of origin.

5. The involvement of the abducens nerves is readily demonstrated by the lantern slide. It will be observed that the nucleus of the sixth nerve lies under the origin of the seventh nerve. Moreover, the fibers of the seventh nerve wind around the nucleus of the sixth nerve in the floor of the fourth ventricle. This tends to prove that the origin of all his trouble thus is a hemorrhage into the nuclei of origin.

6. The reduced unilateral sensation all over the left side of the face may be explained by a consideration of the anatomy of the fifth nerve, and I quote freely from Deaver's *Surgical Anatomy of the Head and Neck*. "The fifth cranial nerve, trigeminus or trifacial, the largest of the cranial nerves, arises

from the sides of the pons by two roots, a large posterior or sensory root, and a smaller anterior or motor root. These can be traced to the floor of the fourth ventricle and to the gray matter in the lower part of the medulla oblongata and in the upper part of the spinal cord. It is the only cranial nerve which resembles a spinal nerve in arising from two roots. The trifacial is a mixed nerve. It distributes sensory filaments to the dura mater, pia mater, orbit, eyelids, nose, gums, teeth, tonsils, palate, sphenoid cells, ethmoid cells, frontal sinus, maxillary sinus, nasal fossæ, pharynx, articulation of the lower jaw, ear, parotid gland, scalp, forehead, face and gustatory filaments to the anterior two-thirds of the tongue." I may state, however, that the distribution to the tongue is otherwise described by other anatomists. The same hemorrhage into the nuclei of origin of the other nerves involved also spread to involve the origin of the left fifth nerve, damaging also his sense of taste.

7. The recession of the eyeballs into the orbit may be explained as due to a trophic change going on in the orbit, probably absorbing some of the fat therein.

Ultimate Conclusion.—Because postmortem examination is impossible, we cannot determine the exact lesion and its location. But when all observations are put together we are almost forced to the conclusion that the nuclei themselves in the floor of the fourth ventricle must have been affected by hemorrhage which as it is absorbing is bringing recovery to the parts affected.

According to Cunningham, the anterior two-thirds of the tongue is supplied by the chorda tympani so far as the taste buds are concerned. The posterior two-thirds is supplied by the glossopharyngeal. The epiglottidean taste buds are supplied by the inferior laryngeal nerve. For general sensation the tongue relies upon the lingual branch of the mandibular division of the fifth nerve.

A remarkable feature of all these cases reported to date is that not one had perished. Hence we are driven to the conclusion that the prognosis is reasonably good, for improvement at least.

Our Compensation Laws.—This patient revealed to me some phases of our compensation laws not noted heretofore. As a

rule, the laws of the various states provide a maximum of sixty days' hospital care and physician's services. Patients injured thus cannot recover in a period of sixty days. Hence the insurance company can hide behind this phase of the law and refuse to pay either the hospital or doctor for more than sixty days' services. Such patients are laboring on comparatively small pay. As matters now stand, the doctor is compelled to stand for what the insurance company should pay. Let us go to our homes in the various states to see that the compensation laws are amended that these companies assume the entire cost of medical and hospital care for these unfortunates, for their pay goes on in a measure until recovery is acquired. We should receive our just dues.

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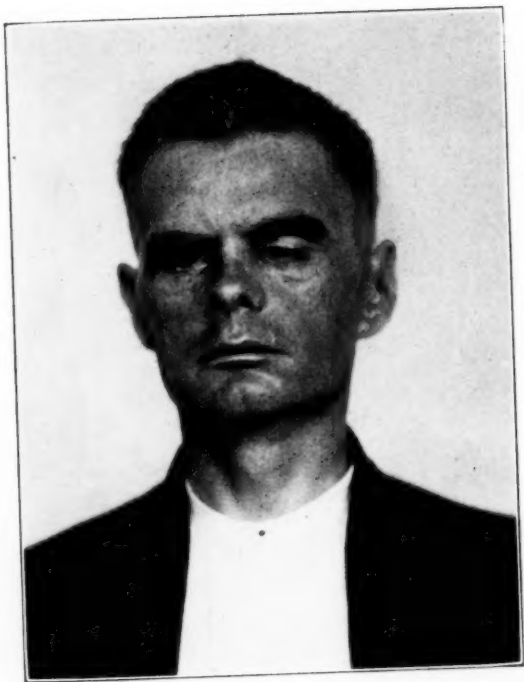
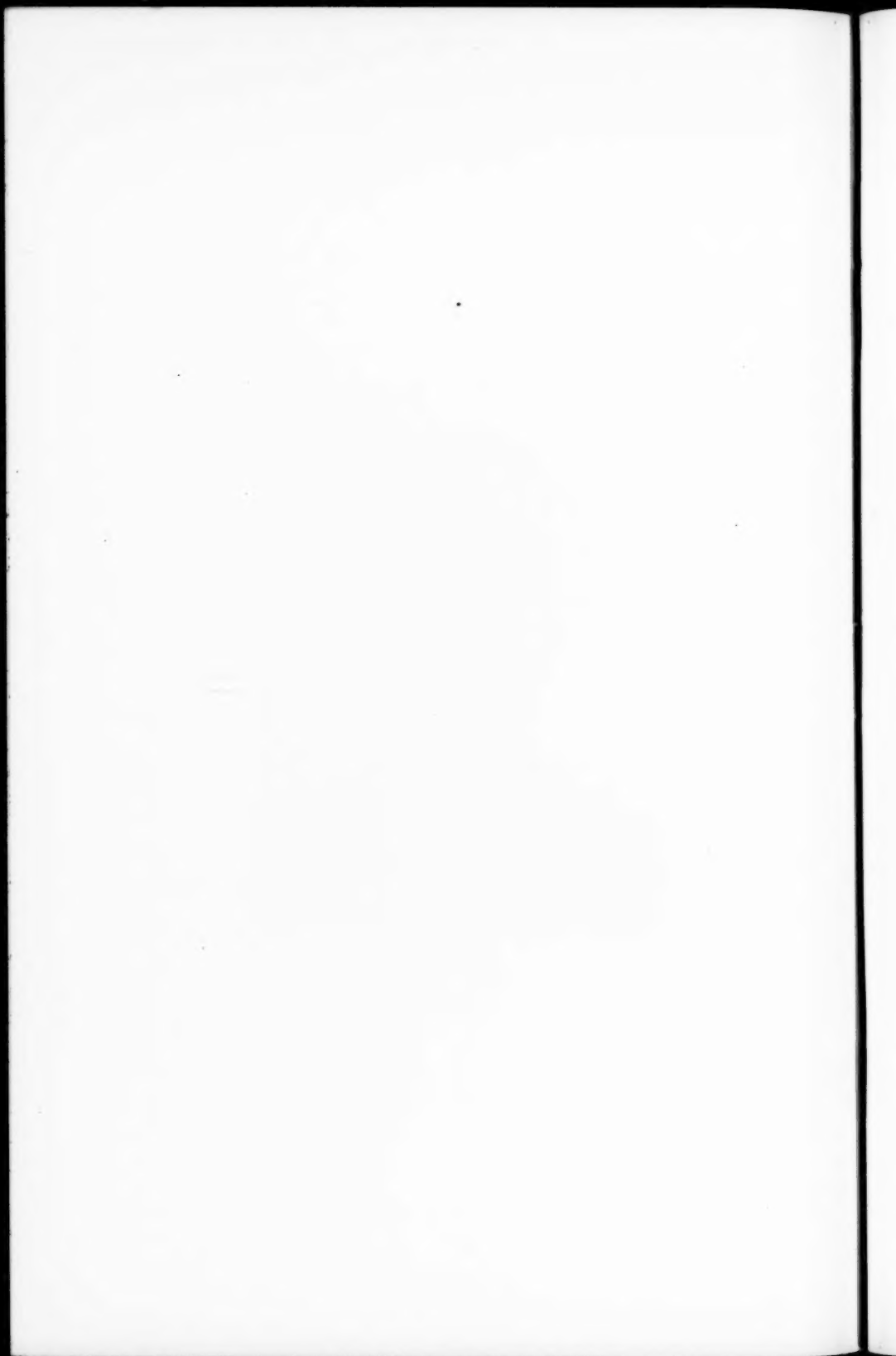


Fig. 1.

Oscar G. His face in repose. Utterly devoid of expression.



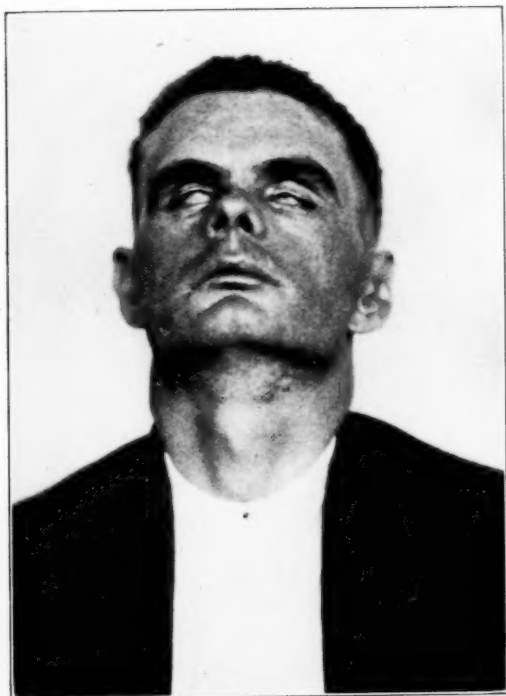
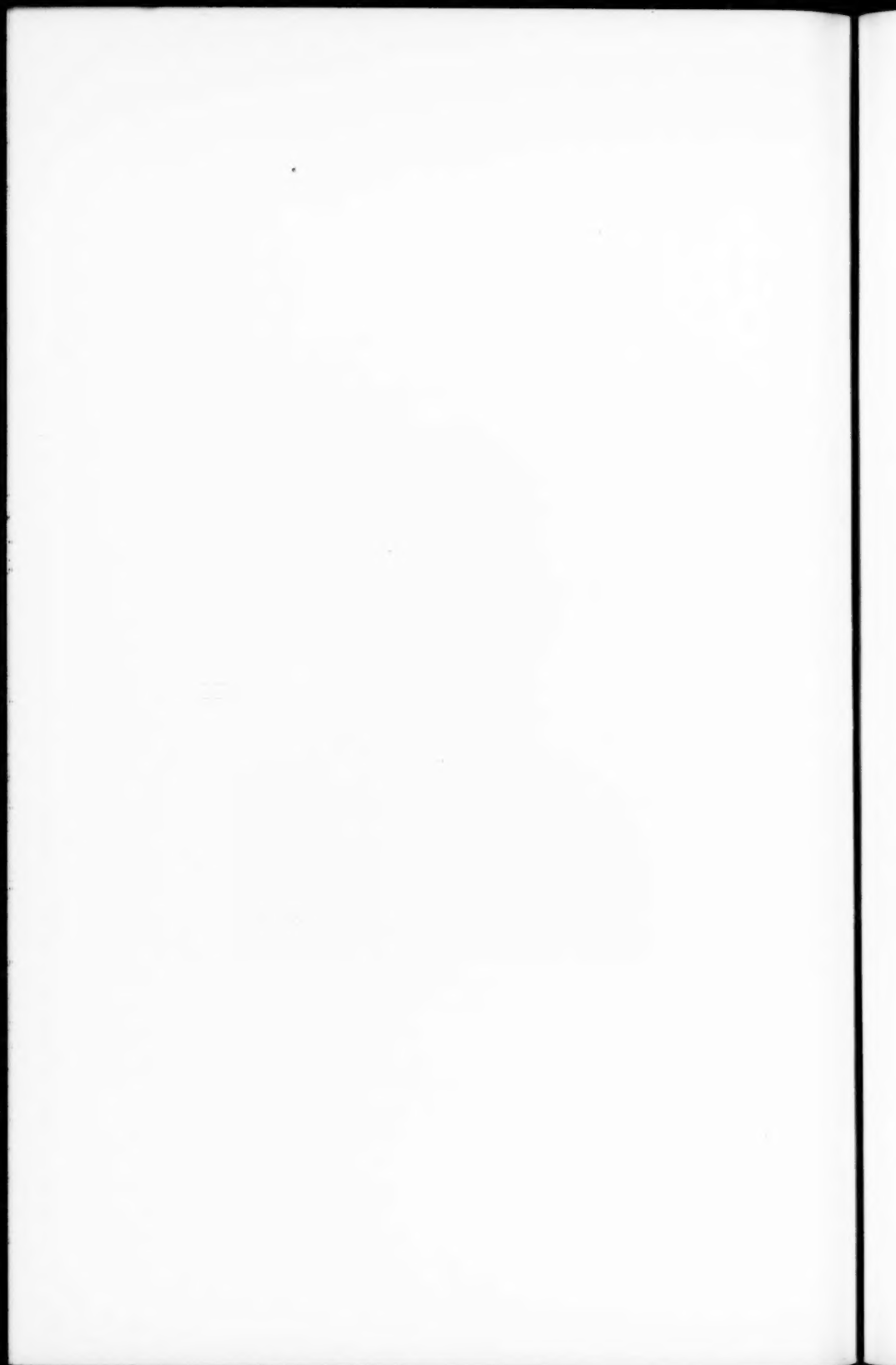


Fig. 2.
Oscar G. He cannot close his eyelids.



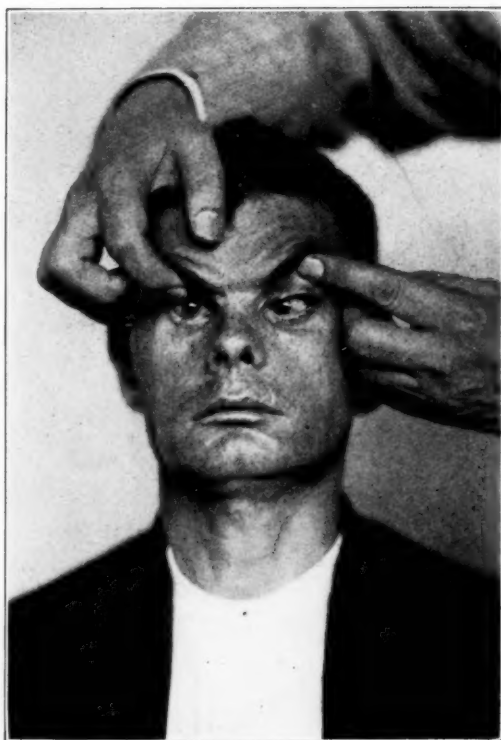


Fig. 3.

Oscar G. The left eyeball inturns markedly and the right one partially.

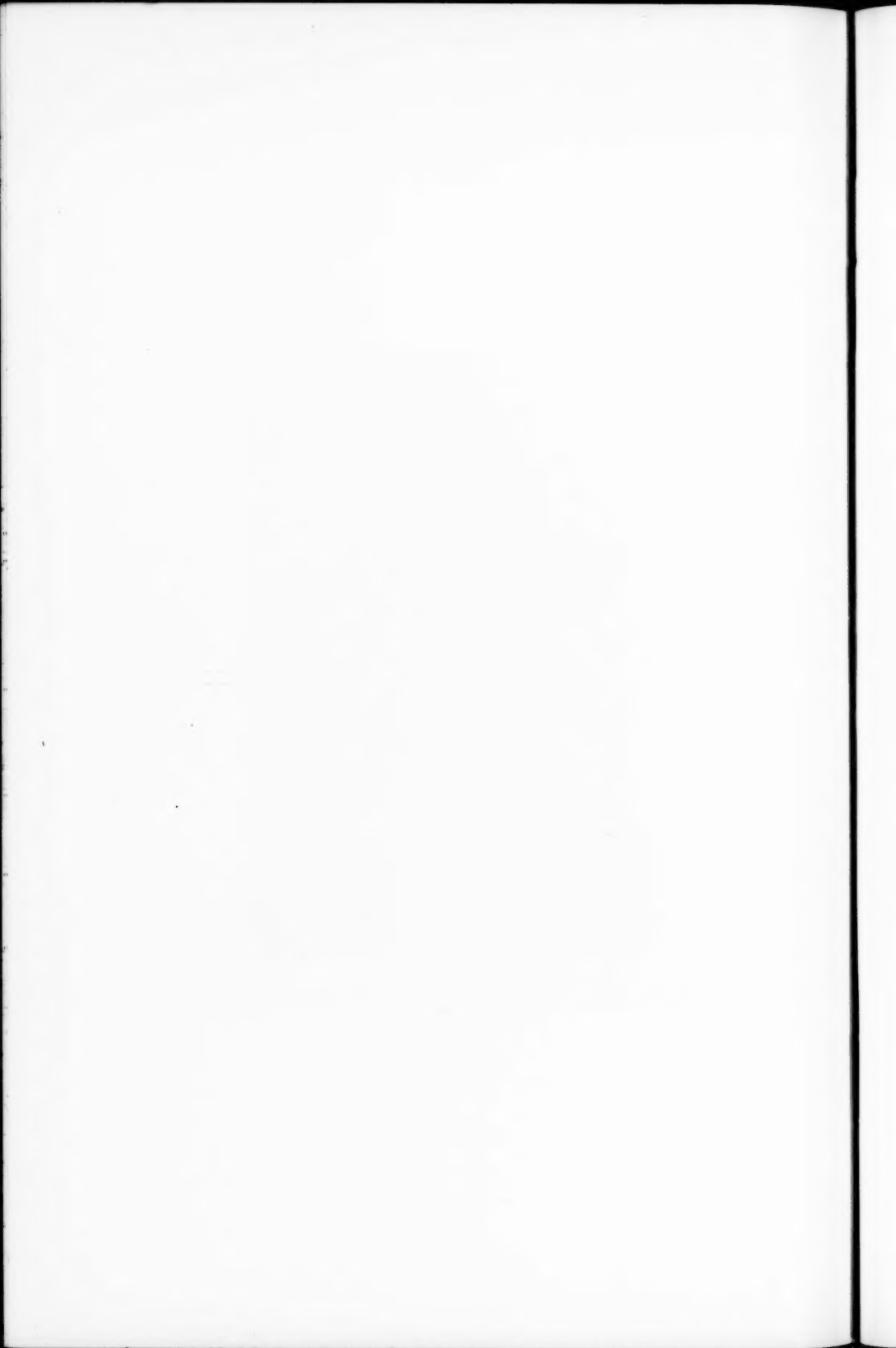




Fig. 4.

Oscar G. The left eyeball refuses outward rotation.

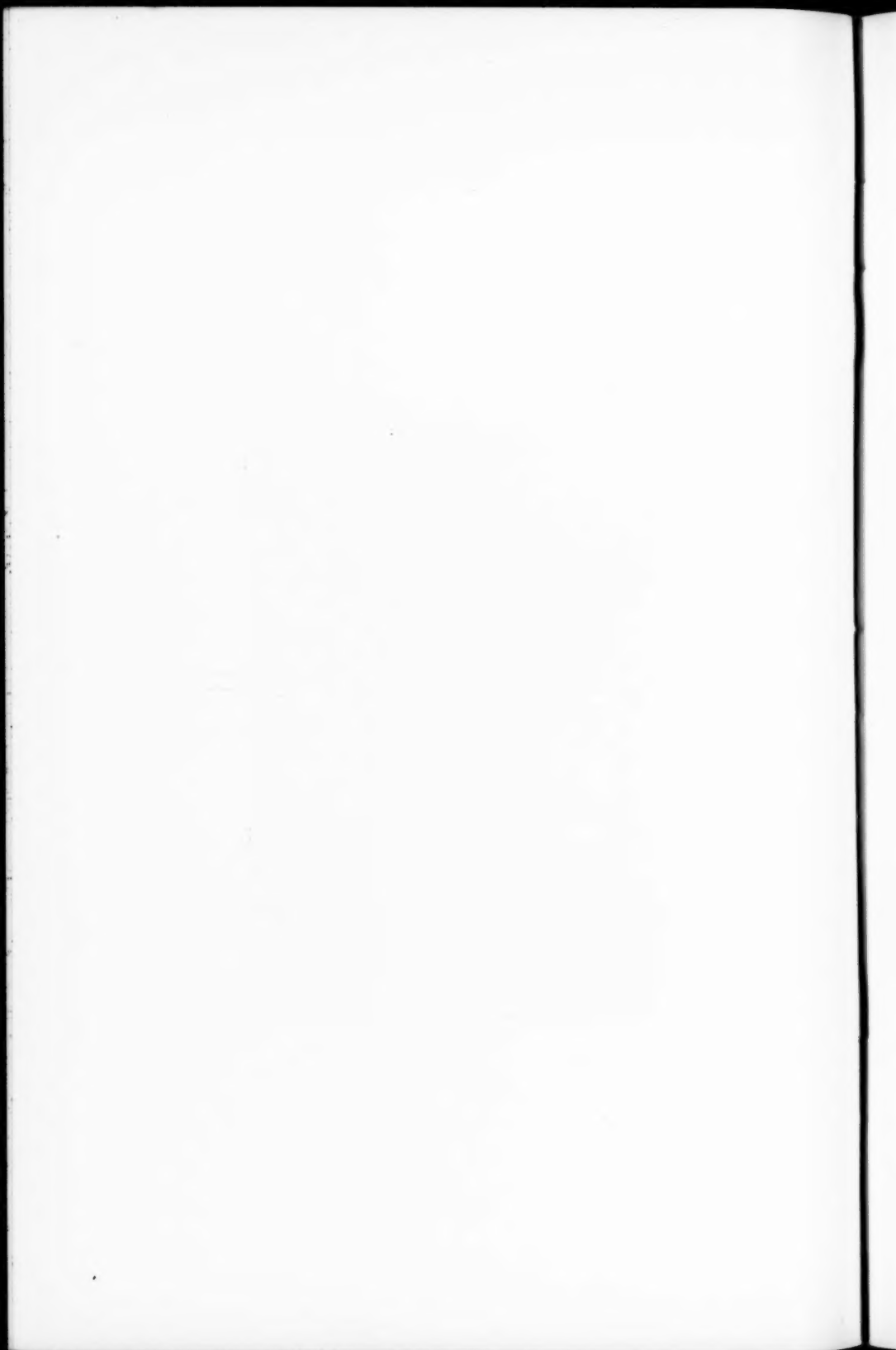
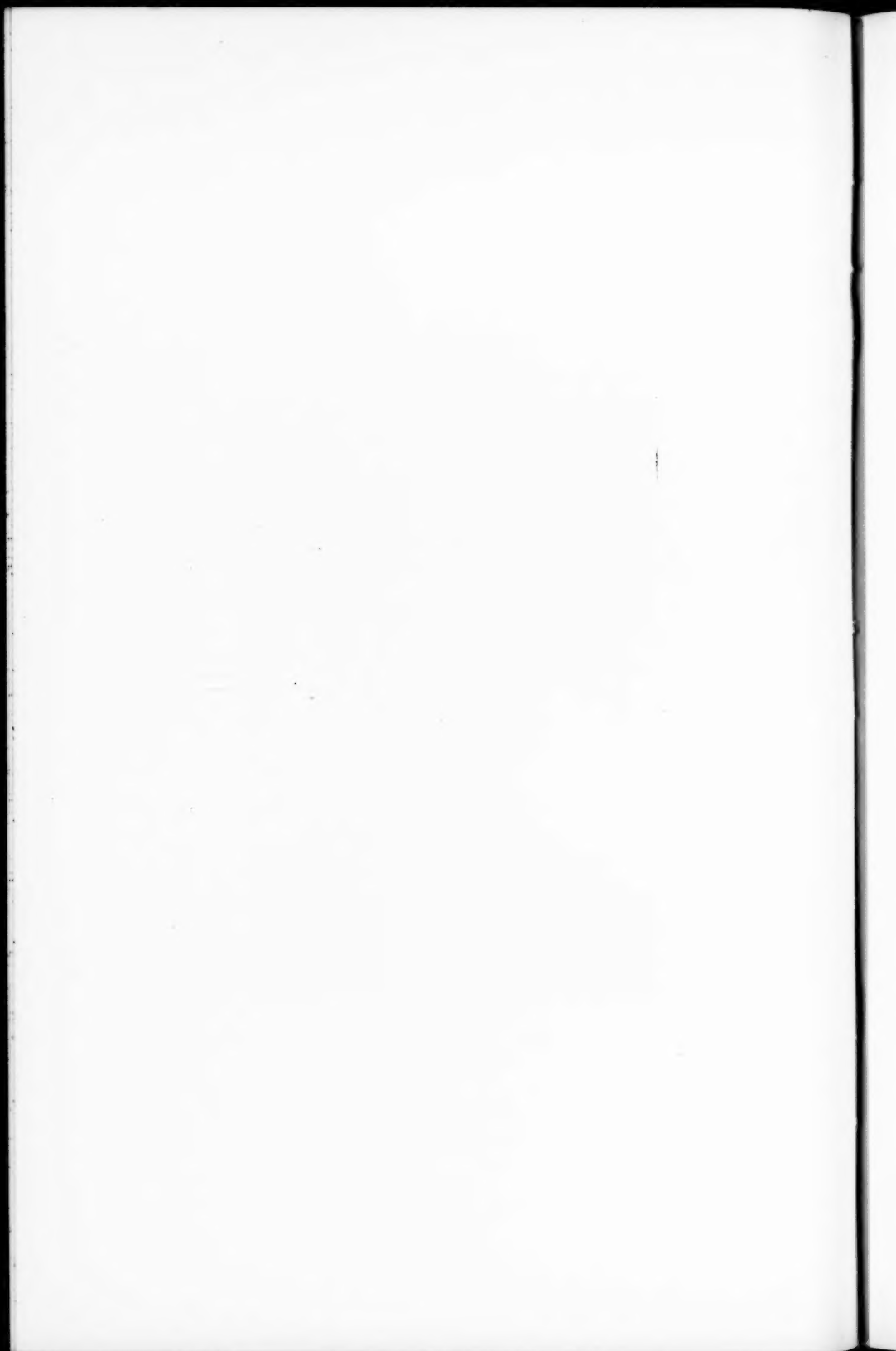




Fig. 5.

Oscar G. The right eyeball refuses perfect outward rotation.



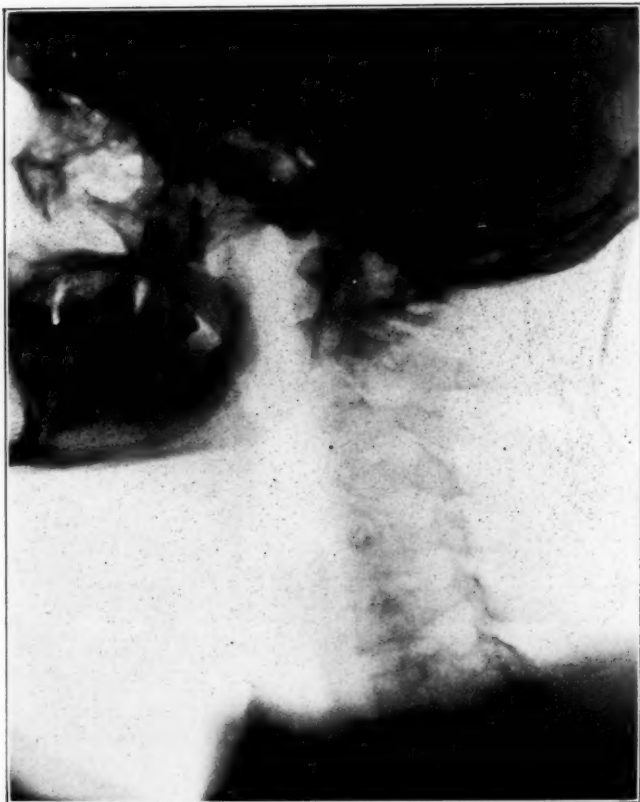


Fig. 6.

Oscar G. X-Ray plate taken shortly after the accident, showing the dislocation of the atlas upon the axis.

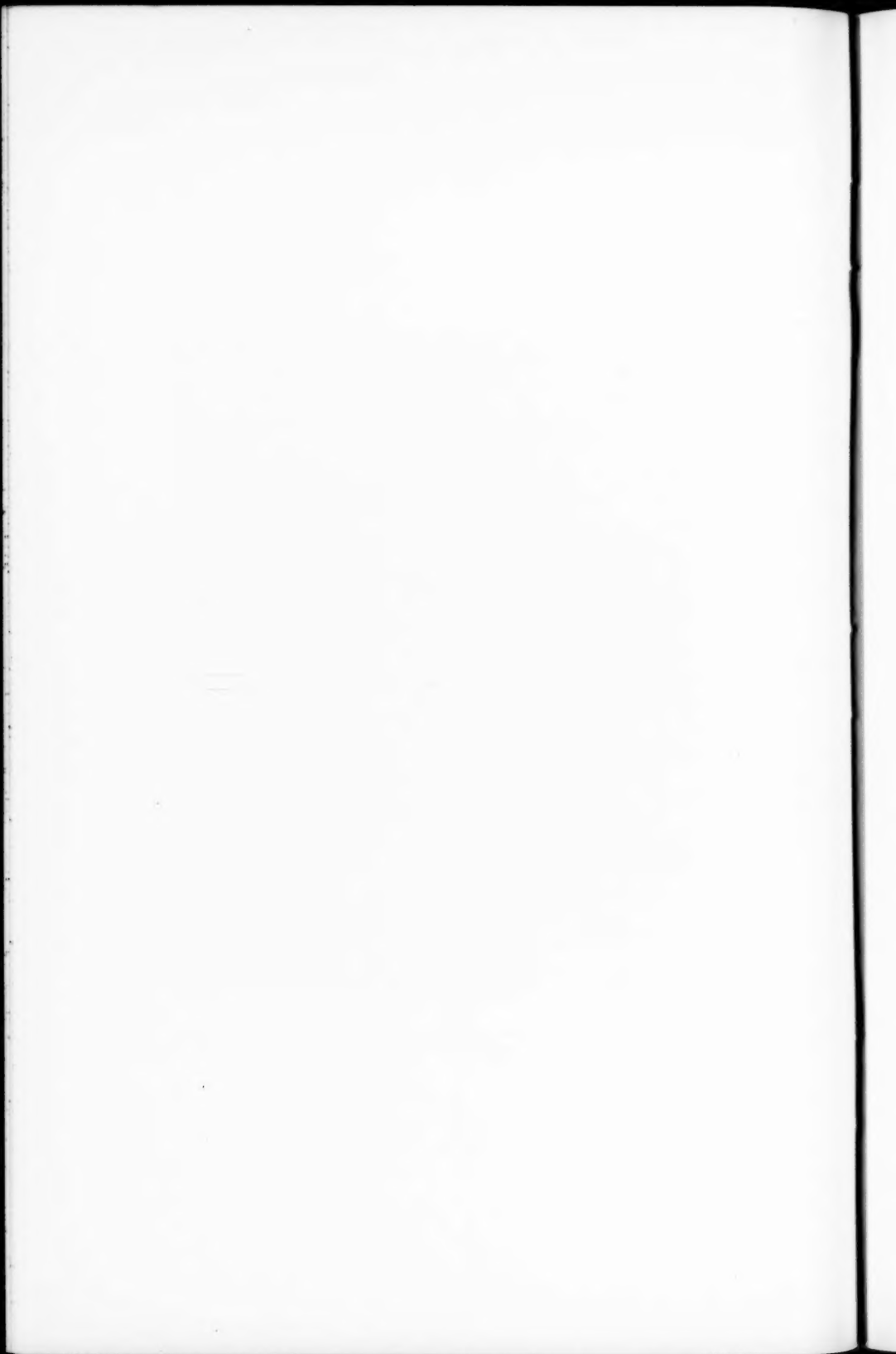
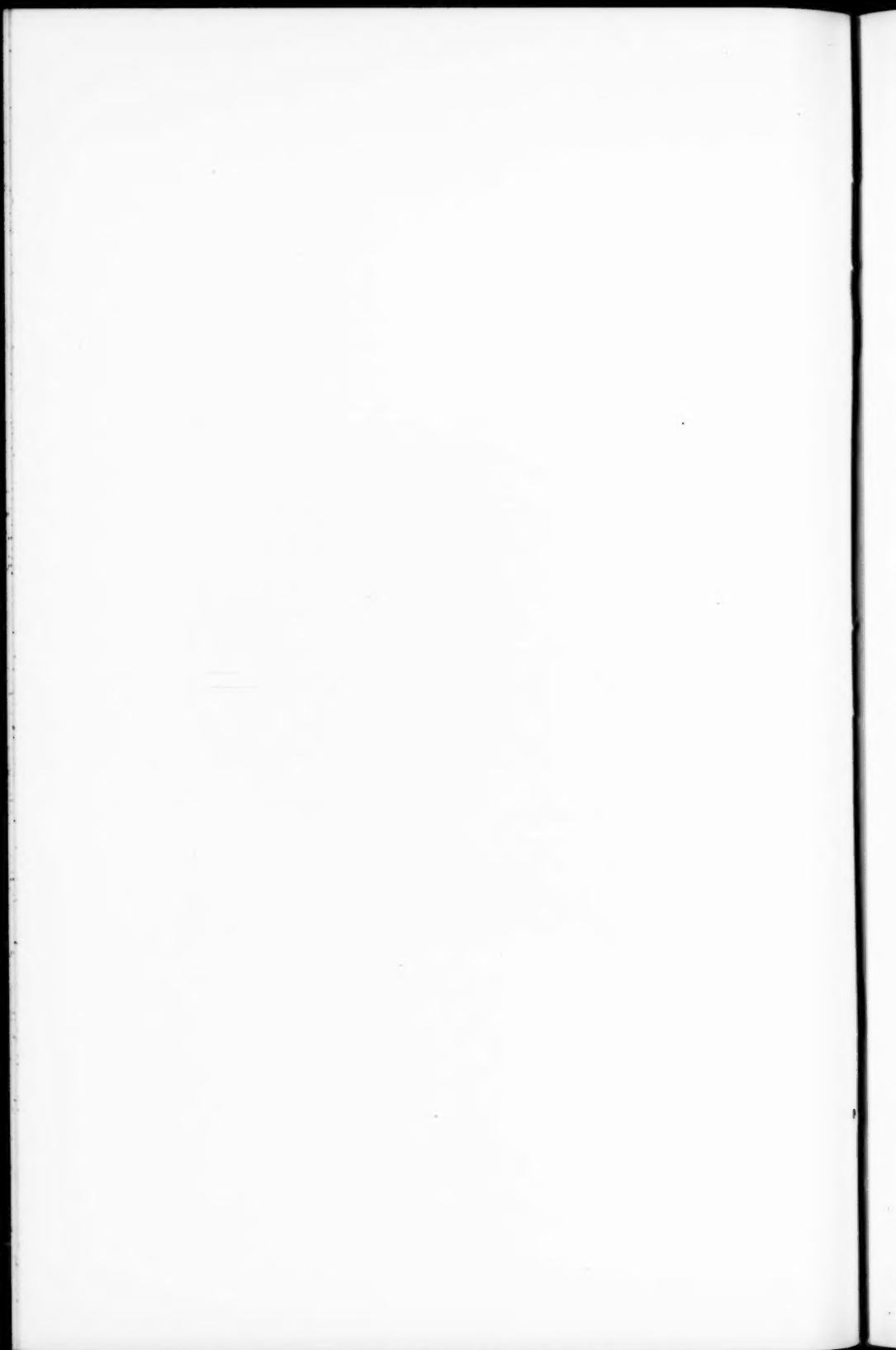




Fig. 7.

Oscar G. X-Ray plate taken Sept. 5th, 1922. The dislocation of the atlas upon the axis still persists.



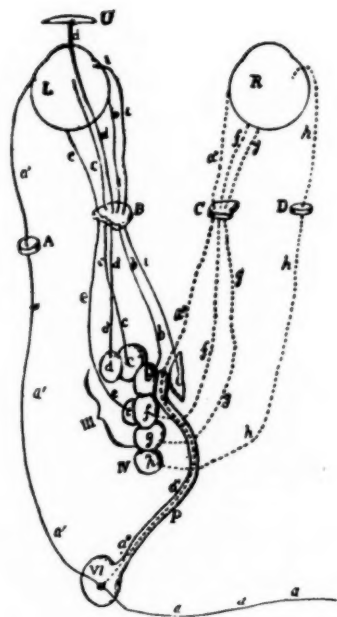
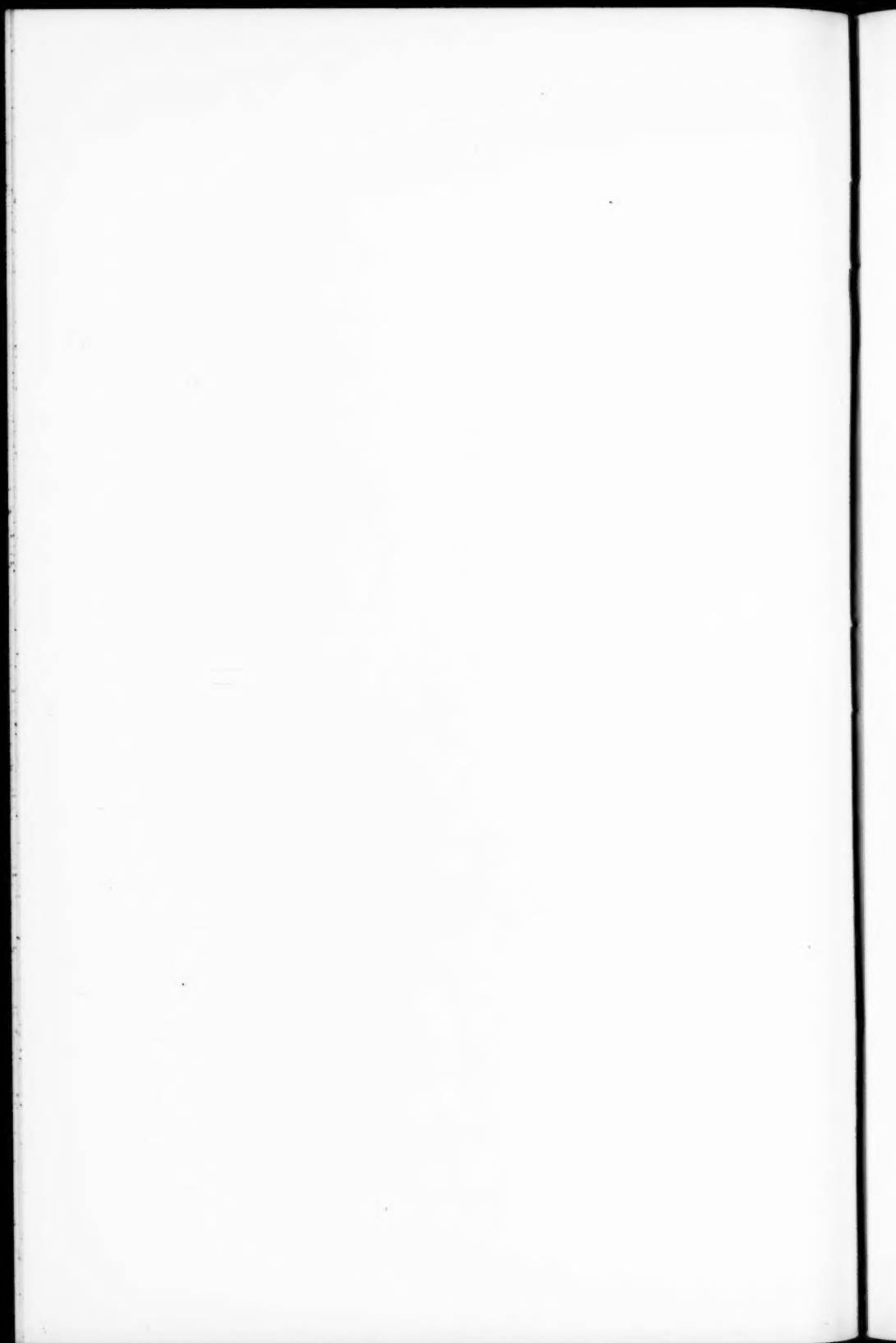


Fig. 8.

Oscar G. To show the distribution of the filaments of the third nerve.



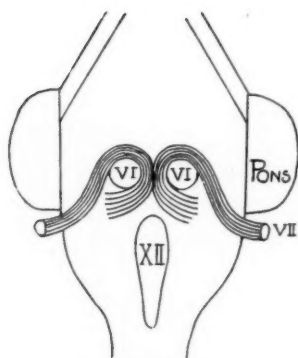


Fig. 9.

Oscar G. Shows how the sixth nerves may be involved with the seventh nerves, at point of origin.

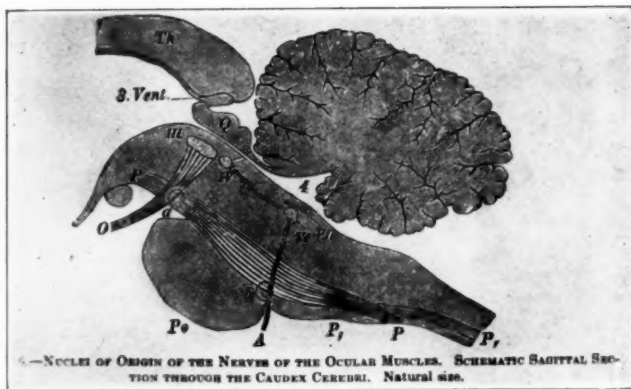
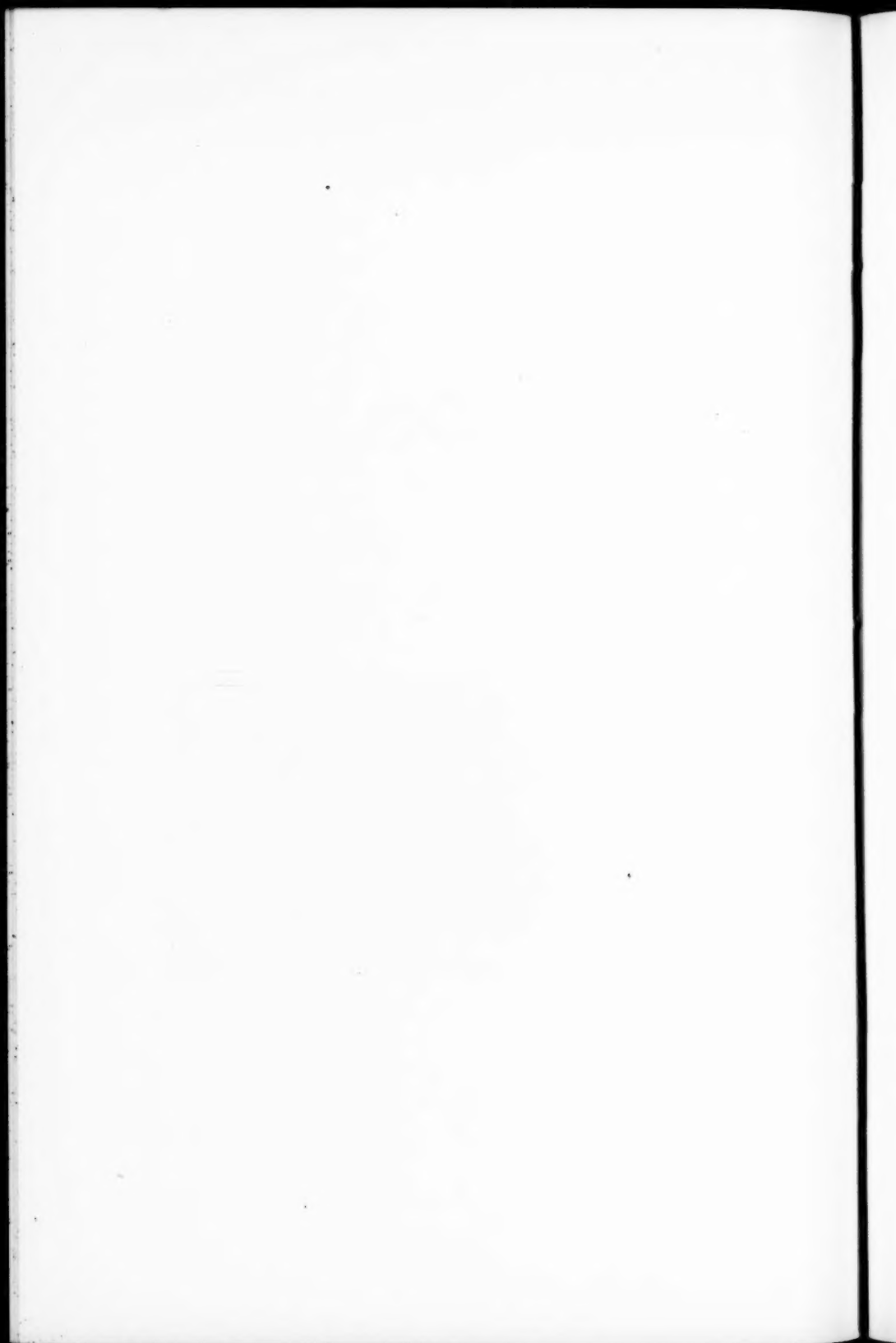


Fig. 10.



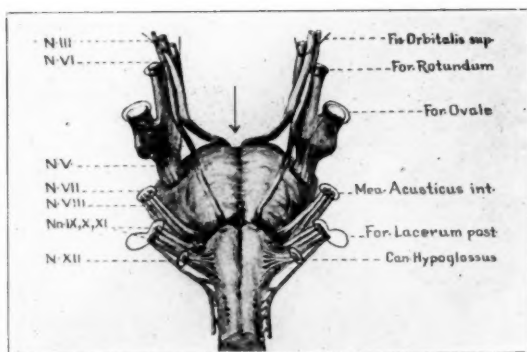
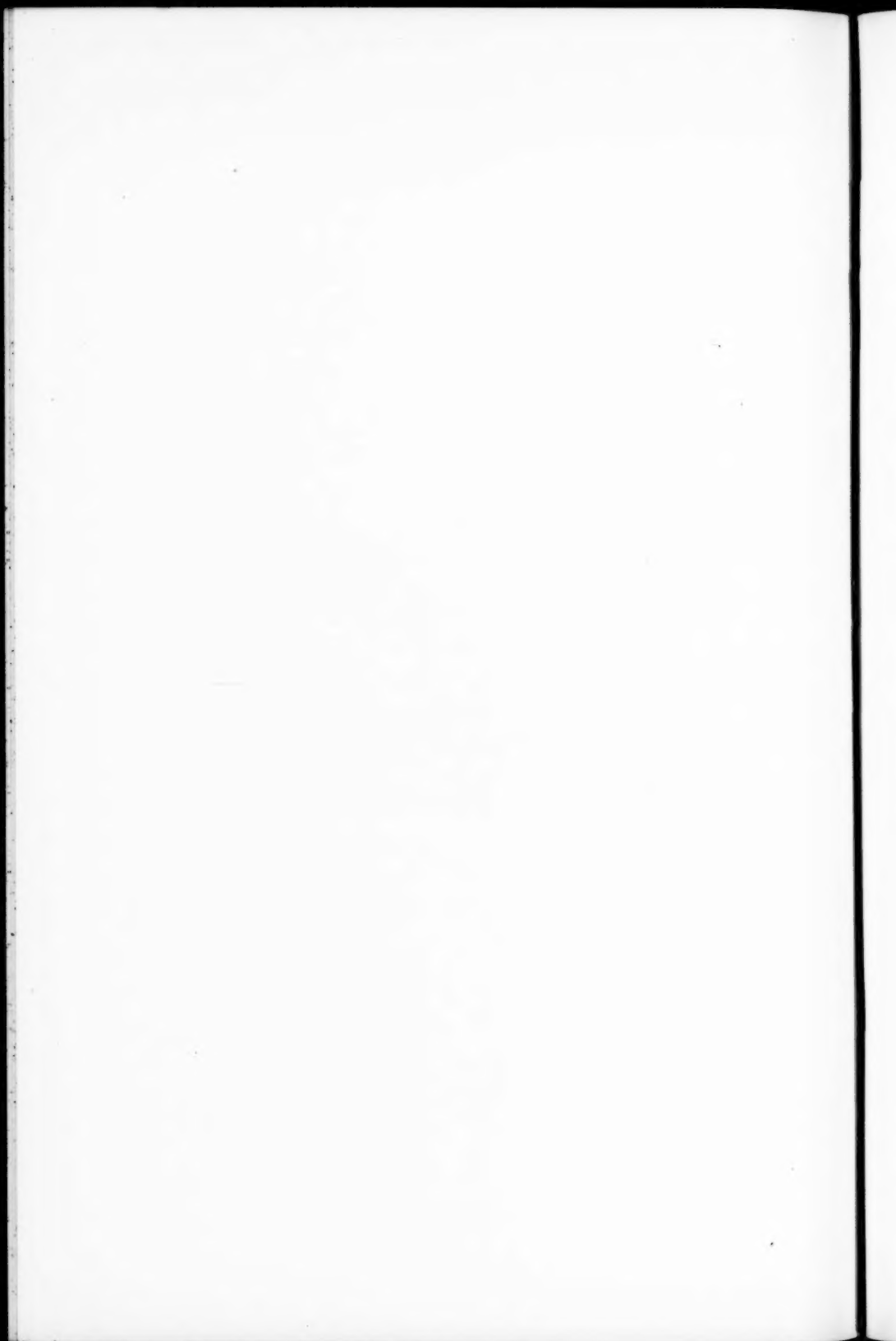


Fig. 11.

Oscar G. How easy for a hemorrhage to pass from one seventh nerve to the other. From Cushing's "Tumors of the Acusticus."



XIX.

TWO CASES OF EMPYEMA OF THE MAXILLARY SINUS OF DENTAL ORIGIN. ALVEOLAR FISTULA. RADICAL AND PLASTIC OPERATION.

BY J. L. MAYBAUM, M. D., F. A. C. S.,
NEW YORK.

The difficulty of successfully eradicating a fistula between the maxillary antrum and the mouth suggested itself as a sufficient reason for presenting these two cases. With few exceptions, these cases are due to alveolar necrosis with antrum involvement or, at least, they are cases of permanent sinus following an operation for antrum suppuration secondary to alveolar necrosis.

Rarely a large infected dentigerous cyst lying external to the antrum and secondarily infecting it may be responsible for the condition.

An alveolar sinus of small caliber responds readily to treatment by the use of cauterizing agents, provided, however, the antrum infection had been eliminated. The problem of obliterating a sinus of larger size is a more difficult one. This can only be accomplished by means of some form of plastic operation, together with a radical antrum operation to provide for thorough drainage through the nose. While little or no difficulty is found in clearing up the antrum suppuration, because of the fact that sutures as ordinarily used are likely to loosen or tear through the mucous membrane, a number of operations may be necessary before the fistula is finally healed. In order to obtain a successful result at the primary operation, it is necessary in the first place to remove enough of the alveolus, having previously separated the mucoperiosteum sufficiently to allow of easy approximation of the flaps without tension, and secondly the sutures are to be applied in a manner to be described, so as to avoid tearing through the flaps.

Case 1.—E. S., age 26 years, referred to me by her dentist, with the following history: Seven months previously she

had the left second bicuspid and first molar teeth extracted. From then until the time I first saw her she had been complaining of more or less constant pain in the left antrum, headache, foul smelling discharge from the nose and a bad taste in her mouth. Patient insisted that she had lost about twenty-five pounds during this period.

Examination of patient: Poorly nourished, anemic individual. Alveolar sinus (left) circular in outline, half inch in diameter. Thick purulent discharge flowing from sinus into mouth. Probe entered the antrum for a considerable distance to the orbital wall; rough bone in sinus wall. Examination of nose disclosed purulent discharge in middle meatus, and on irrigating the antrum through the alveolar sinus pus flowed freely from the left nasal chamber. The only treatment the patient had received from her dentist throughout the seven months had been saline irrigations and packing the fistula on alternate days. The technic I employed as regards the antrum operation differed in no way from the classical Caldwell-Luc operation, except that the gingival incision was made at a higher level than usual, in order to allow for a fairly good size flap in attempting to close the large fistula.

The procedure of closing the fistula consisted of extending the incision through the mucoperiosteum from the margin of the fistula in an anterior and posterior direction for a distance of one inch. I then elevated the mucoperiosteum on the inner and outer surface of the alveolus, removing enough of the latter so as to readily bring together the two flaps. Black silk, No. 4, was used as suturing material. Suppuration from the antrum ceased entirely after a time, but sutures closing the fistula became loose, so that the fistula was as widely open as before the operation. In consulting the literature on the subject, I found that Dr. L. W. Dean of Iowa City had after many trials succeeded in devising a method of procedure which resulted in successful closure of these sinuses in a majority of his twenty-three cases at the primary operation.

This method I followed at the second attempt to close the fistula, with complete success. Briefly, the method is as follows: If the operation is done at the time of the antrum operation, as it ordinarily should be, the incision for the

Caldwell-Luc is made high up and entirely separate from the incision on the border of the alveolar process. After completing the Caldwell-Luc operation and being sure that there is excellent drainage into the nose, the alveolar process is attacked. The necrotic bone is completely removed, and enough of the inner and outer lamella of the alveolar process is removed to allow of perfect apposition of the flaps that have been previously lifted from its inner and outer surface. It is necessary to have these flaps come together nicely in order to avoid any tension on the sutures. Silkworm sutures are used instead of silk, as these can be kept clean and hold several days longer than silk. At this point a piece of small rubber tube sufficiently long to allow it to be tucked underneath all the sutures is placed on the inner and outer surface of the alveolar process.

Using double armed silkworm sutures, a sufficient number are introduced from the inner flap and through the outer, the loops resting on the rubber tubing on the inner surface of the alveolar process, the knots being tied on the rubber tubing on the outer surface of the alveolar process. The sutures should be tied tight enough, without getting them so tight as to produce pressure necrosis of the flap. The alveolar sinus in the case of my patient was completely healed one week after the operation.

Case 2.—The problem in this case was far more difficult than that of the previous one.

The patient, age 38 years, gave a history which differed in no respect from that of the previous case, except that six weeks following the extraction of three teeth her dentist had found it necessary to remove a considerable amount of bone from the alveolar process and the anterior wall of the antrum, because of an extensive necrotic process. For a period of four months following this the only treatment she had received was daily irrigations and packing.

On retracting the upper lip, I found a large defect, circular in outline, involving practically the entire anterior wall of the antrum. The interior of the antrum, containing foul smelling pus and granulation, came readily into view. Because of the extensive loss of tissue I offered little hope of completely closing the opening.

Under local anesthesia the interior of the antrum was carefully curetted and a large opening made below the inferior turbinate. I then elevated the mucoperiosteum for a distance of three-quarters to one inch from the border of the large defect and made an incision, as in the previous case, in a posterior and anterior direction. Silkworm sutures were used to bring the flaps together; this could barely be accomplished. Some of the sutures loosened after a few days; the opening, however, was reduced about one-third its former size. A second attempt at closing the opening was made six weeks later, with a further reduction in size. At the present time examination discloses an antrum no longer suppurating and considerably smaller in size, and an opening above the alveolaris one-quarter of an inch in diameter. This opening can be closed without any further trouble. Had the method followed in the first case been known to me and used in this case the large opening in the antrum would have been completely obliterated in all probability, at the first operation.

1 WEST 70TH STREET.

XX.

CHRONIC SUPPURATIVE OTITIS MEDIA.

BY HERRMANN E. BOZER, M. D.,

SECTION ON OTOLARYNGOLOGY AND RHINOLOGY, MAYO CLINIC,

ROCHESTER, MINNESOTA.

During the treatment of chronic suppurative otitis media the question often arise, "How long will the ear remain in good condition after it has become dry and the pathologic condition has been arrested, or apparently cured, and what are the factors that will tend to cause it to revert to its previously diseased condition? This is important, both to the patient and to the physician. The patient quite often is under considerable expense and, after having obtained an apparent cure, is anxious to know how permanent it will be. The physician is called on to give an opinion and it is his duty to advise the patient, not only concerning the future care of the ear and the prevention of recurrences, but to render a fair prognosis as to the permanency of cure.

I have studied the results in 190 selected cases in which treatment was given for chronic suppurative otitis media in the Mayo clinic. In none of these cases was chronic supuration influenced by malignancy, mycosis, or any constitutional disease, such as diabetes, active tuberculosis, or syphilis. All of the patients had been treated within a period of one and one-half years, the shortest time since treatment being one year. All of these patients had continued treatment until it was felt that no further benefit could be derived therefrom. In the majority of cases, the disease process had apparently been controlled so that the affected ear had remained dry for at least one week before the patient was dismissed from the clinic. The smaller group of patients had not responded so well, there being still a little moisture in the middle ear at the time of dismissal. Patients on whom the physician was permitted to use every available means have not been included in this study.

The treatment was essentially a combination of the antiseptic, alcohol and caustic methods described by Politzer, varying in each case with the type of the disease process. All obstructions to drainage, such as crusted adherent bands and necrosed ossicles, were removed as far as possible and daily cleansing of the middle ear and attic regions was instituted. This was accomplished by filling the ear with hydrogen peroxid and allowing it to remain for several minutes. The ear was then carefully wiped dry with cotton on an applicator. A 50 per cent solution of alcohol, containing 3 per cent of boric acid and .05 per cent mercuric bichlorid was then instilled into the ear and allowed to remain a few minutes. This also was carefully wiped out and the drying process completed by directing air under pressure into the aural cavity. Care was taken that the current of air was not strong enough to produce vertigo by causing too rapid evaporation. No other type of treatment, such as vaccin therapy, ionization methods, roentgen ray or radium, was used. Any disease in the nose and throat was carefully eliminated as far as possible, and the patient's general condition thoroughly investigated and cared for. The extent of suppuration in the affected ears of all the patients was carefully graded clinically at the time of treatment. The method of classification is purely empirical and is based on the extent and location of the disease process in the ear. In the main, four types of suppuration were recognized.

Type 1 includes cases in which the discharge was thin, viscid, and mucoid, and arose solely from the eustachian tube. The perforation generally is quite large and is usually situated in the anterior inferior quadrant, although at times the whole of the tympanic membrane may be absent, owing to a former active suppurative process of the middle ear, which has since healed.

Type 2 includes cases in which the suppurative process was confined to the hypotympanum and mesotympanum. The perforation of the tympanic membrane may be large or small and situated any place in the pars tensa. The mucous membranes lining the tympanic cavity are often markedly thickened, granular in appearance, and secrete a thick mucoid fluid containing many leukocytes. Areas of necrosis of the bony

walls may be present, and occasionally necrosis of the lower portion of the ossicle may be demonstrated.

Type 3 includes cases in which the suppurative process and necrosis involve the attic as well as the lower portions of the tympanum. Quite often the perforation of the tympanic membrane is in Shrapnell's membrane and most of the suppurative process is concealed from inspection. Generally, however, the attic seems to be involved secondarily, so that Shrapnell's membrane is intact. A probe introduced from below the level of the anterior and posterior folds will find free access into the attic and will quite often dislodge masses of thickened discharge, fragments of necrosed ossicles, and portions of cholesteatoma, which have collected in that region.

Type 4 includes cases in which there is definite suppuration of the antrum and the adjacent mastoid cells as well as suppuration and necrosis of the lower portions of the tympanum. This is quite often demonstrated by fistulous tracts from the posterior canal wall leading into the mastoid cells, the walls of which are often necrotic or have been eroded by cholesteatoma. Occasionally, the aditus ad antrum is so enlarged by cholesteatoma that the anatomic effect of a radical mastoid operation is produced. A radical mastoid operation is indicated in all cases of this type. Preparatory treatment is given before operation with the intention of cleansing the middle ear and its appendages as much as possible in order that the postoperative care may be shortened. An open tube, contributory to the discharge, may be present in any of the foregoing types.

Ninety-six replies were received from 190 patients to whom questionnaires were mailed. In seventy-eight patients (81 per cent) the discharge had entirely ceased and no apparent suppuration was present when the patient left the clinic. In forty-two (54 per cent) the ears remained dry, and in thirty-six (46 per cent) they did not. In eighteen (19 per cent) the discharge had not entirely disappeared at the time of dismissal. In two patients the ears became dry without further treatment, and in sixteen the ears continued to discharge.

Of the forty-four whose ears remained in good condition there were twenty-four males and twenty females. The average

age was thirty-four years. The average duration of the disease before treatment at the clinic was about fourteen years, the time varying from two months to fifty years. Of these patients, twenty had had a constant discharge, while twenty-four had had intermittent discharge, that is, there were intervals during which the ears had apparently been dry. As a rule these periods of quiescence were of short duration, generally lasting only a few months.

Of the patients whose ears did not remain in good condition there were twenty-eight males and twenty-three females. The average age was twenty-four. The average duration of disease was about twelve years, the shortest being three months and the longest thirty-six years. Twenty-one patients had had constant discharge and twenty-nine intermittent discharge.

The sex and age of the patient apparently were not factors in the ultimate results. Constancy of discharge does not seem to be an unfavorable factor. It would also seem that a few years' duration, more or less, would make but little difference in a group in which the duration of the disease is of such length, the average being thirteen years.

The average duration of treatment in the patients who remained in good condition was 3.6 weeks. In those who failed to remain in good condition, the average duration of treatment was 4.7 weeks. Failure to obtain good results cannot be attributed to less effort spent in treatment.

An attempt was made to determine what effect, if any, the etiologic factors in the suppurative process had on the results of treatment. Many cases were of such long standing, however, that the patients were unable to recall the exciting cause. The statistics obtained were thus too limited to justify an attempt to draw any conclusions. It does seem, however, that those cases originating from scarlet fever are very resistant to treatment, and the percentage of failures is as high in this type as in any other type.

As has already been mentioned, an attempt to classify the extent of the disease process of the affected ears was made at the time of the first examination. In order to determine the value of the classification as an aid to prognosis in the results

of local treatment, the ultimate results of treatment in each type are shown in Table 1.

The percentage of good results is no higher in Types 1 and 2 than in the more dangerous, Types 3 and 4. The only factor to cause recurrence of discharge, present in all types to about the same degree, was an open tube. This is the explanation of what, to the patient, is quite paradoxical; that an innocent aural discharge from what was considered an innocent type of ear should recur after apparent cure as easily as that in an ear which is considered quite dangerous. As all these patients could not be examined by us, it was necessary to accept the patient's statement as to the condition of the ear. No doubt many of the Type 3 ears were discharging only because of an open tube, and the attic was still in a good condition. For these reasons I believe that any classification which fails to consider the patency of the tube offers no aid in the prognosis of the permanency of the cessation of discharges; but I am quite sure that such a classification as I have mentioned offers a satisfactory method of measuring the danger to life of any particular suppurating ear.

Lillie¹ has called attention to the fact that those ears in which the functioning membrane has not been completely destroyed are apt to show moisture at times after all active suppuration has been eradicated. Any congestion of the membrane, such as may occur during acute infections of the upper respiratory tract, will cause hypersecretion and result in a moist middle ear cavity. If this membrane has been completely destroyed by the previous suppurative process, however, and the middle ear is lined only by scar tissue, the ear is much more apt to remain dry. This is an element which must also be considered with an open tube in dealing with the prognosis of permanency of cure after treatment of chronic suppurative otitis media.

Occasionally, because of extensive involvement of the attic, it is inferred that the antrum and probably the adjacent mastoid cells must also be affected. Such ears may clear up under treatment and I believe that the two Type 4 ears in this series that responded to treatment were probably of this kind, and that the actual disease process was not so extensive as it appeared to be at first examination.

Lillie² has recently emphasized the importance of exercising care in blowing the nose when there is chronic discharge with patent tube. In this series I attempted to determine to how great an extent this was noticeable to the patients themselves. Table 2 indicates the results obtained in eighty-one patients who were careful not to produce undue back pressure in the nasopharynx and eustachian tube when blowing the nose.

Of eighty-one patients who were careful in blowing their noses 31 per cent reported that this had a decidedly beneficial effect in keeping their ears from discharging. Twenty-eight per cent were sure it had no effect, and 41 per cent were undecided.

There is very little difference in response between the Type 2 ears, which also included the Type 1 and the Type 3 ears. It must be taken into consideration that many of the Type 3 ears also had open tubes and consequently responded to this precaution. This is good reason for suspecting that many of the Type 3 ears, reported to have begun discharging again after apparent cure, were only doing so because of open tubes, and not because the former suppuration in the attics had recurred. These statistics again point to the view that the prognosis of cure from the patient's standpoint, that is, permanent cessation of discharge, cannot be based alone on the actual extent of the suppurative process in the middle ear and its appendages. To a large extent, prognosis must depend on the condition of the tube. This is strictly in conformance with the view of Yankauer.

Ears which have once discharged and have responded to local treatment often become affected during "colds" in the head. Of the fifty-one cases in which the ears were discharging at the end of one year after treatment in twenty-nine the recurrence began with colds. As this included fourteen in which cure had not been complete at the time of dismissal, this number must be deducted. Thus twenty-nine of thirty-seven recurrences (78 per cent) were due to colds, and probably to the consequent nose blowing.

SUMMARY.

About 50 per cent of the patients with chronic suppurative otitis media, who have responded satisfactorily to local treat-

ment through the external auditory meatus, remained in good condition for a period of from one to two and one-half years. An ear that remains in good condition for this length of time holds but little danger to the patient's life, if proper precautions are observed. Many of the patients in this series responded to treatment, although the disease had been of many years' duration. Failure to secure closure of the eustachian tube is a big factor in the failure to keep an ear in good condition after an apparent cure has once been obtained. Care in the manner of blowing the nose is very beneficial in keeping an ear in good condition in about 30 per cent of cases.

CONCLUSIONS.

1. About 50 per cent of the patients with long standing, chronic, suppurative otitis media who have responded satisfactorily to treatment remain in good condition for a period of at least one to two and one-half years.
2. Sex, age, and constancy of discharge have no apparent effect on the permanency of the cure.
3. Long duration of discharge is not necessarily an unfavorable factor.
4. The patency of the eustachian tube and the presence of functioning membrane in the middle ear must be taken into consideration with the type of disease when offering a prognosis as to the permanency of cure.
5. Local treatment must be well directed and persistent.
6. Care in the nose blowing habit is an important factor in keeping an ear dry in at least 30 per cent of the cases; this depends on the condition of the tube and not on the disease in the ear.
7. Many patients whose ears were cured and remained dry would have had a mastoid operation, if a conservative view had not been taken and persistent local treatment kept up.
8. It is reasonably safe to assume that the suppurative ear conditions which have responded well to treatment will do so again.
9. Discharge from the tube, after the suppurative process has been controlled, may be considered of minor importance as far as real danger is concerned.

TABLE I.

Type	Results of Treatment.	
	Good	Unsatisfactory
1	6	6
2	24	27
3	13	15
4	2	3

TABLE II.

Effect on Discharge of Care in Nose Blowing.					
Results	Number	Per cent	Type 2	Type 3	Type 4
Questionable	33	41			
Good	35	31	14	10	1
No effect	23	28	10	9	4

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XXI.

COMPLICATIONS OF PARANASAL SINUS DISEASE IN INFANTS AND YOUNG CHILDREN.

BY L. W. DEAN, M. D.,

IOWA CITY.

The most serious result of paranasal sinus disease in infants and young children is death.

An infant, two months of age, came into our service in an extremely critical condition, with a hemolytic streptococcic infection of paranasal sinuses and ears. The mastoids were drained with improvement. The paranasal sinus disease was treated. When the infant died the opinion was given that the cause of death was paranasal sinus disease. I was anxious to get the very best possible opinion about this case, so the autopsy was held by Drs. Medlar and Armstrong, the two pathologists of the University Hospital, together. The mastoid wounds were clean. The superior and inferior meati of each side of the nose were filled with large accumulations of pus, which seemed to come from the paranasal sinuses under pressure. In each maxillary sinus pus under great pressure was found. A complete general examination was made with negative findings. The pathologists expressed the opinion definitely that the cause of death was the paranasal sinus disease.

Another infant, six weeks of age, with a similar history died while it was under treatment for paranasal sinus disease of streptococcic origin. Both of these infants were very sick children when they came into our service. They were so sick that it was necessary to feed them by lavage. When an infant two or three months of age comes into our service with a temperature of $105\frac{1}{2}$, due to paranasal sinus disease, and we get the child early before the gastrointestinal disturbances are marked the prognosis is very good. If when the treatment is begun the child has reached a stage where it will no longer take nourishment of itself the prognosis is very bad. This

second infant who died, like the first, had pus under pressure in every paranasal sinus. The pathologist stated that this was the cause of death.

There may be an interdependence between chronic multiple infectious arthritis and paranasal sinus disease in infants and young children. This may be present at the age of three.

On December 4, 1918, Baby E. T., age three, was referred to us by Dr. Steindler for examination for focus of infection in the upper respiratory tract. His diagnosis was chronic multiple infectious arthritis. We found chronic tonsillitis, adenoids, plus bilateral maxillary sinusitis. A hemolytic streptococcus was secured from both the maxillary sinuses and from the tonsils which, when injected into a rabbit, caused arthritis. The tonsils and adenoids were removed and the diseased maxillary sinuses treated by simple irrigation with argyrol. The sinus disease apparently disappeared but, while the arthritis was improved, it persisted. Six months later an opening was made in each maxillary sinus through the antromental wall and the sinuses treated. The sinus disease disappeared and with it the acute joint trouble. Two years after this, on July 6th last, the mother of the little girl brought her into the pediatric service. The mother stated that since the little girl left the hospital two years ago she has been much improved; the first year she had apparently perfect health, but last winter, following a severe cold, she had considerable nasal discharge. There was no trouble with arthritis at this time; two weeks ago she developed a stiff and swollen left ankle. Examination revealed pus in each maxillary sinus. A small opening was made in the antromental wall and the maxillary sinuses irrigated; vaccines were used with an apparent disappearance of the maxillary sinus disease and of the acute manifestations of the arthritis. Several weeks ago I saw this child. She is perfectly well. She can dance and play as well as any child.

Naturally, when her sinus disease was being treated Dr. Steindler also gave the proper orthopedic treatment to the joint.

This case illustrates two things. First, that paranasal sinus disease may cause systemic infection at the age of three.

Secondly, that paranasal sinus disease in infants and young children is sometimes not easy to permanently cure.

D. M., now nine years of age, is one of our most instructive cases. A brief resume of the case is as follows: When she was four years of age I removed her tonsils and adenoids with much improvement. That was in 1916, when we were not examining our four-year-old children for paranasal sinus disease. The little friend of ours would be today much better off if in 1916 we had examined, diagnosed and treated the paranasal sinus disease which was undoubtedly present. When seven years of age we diagnosed a bilateral sphenoiditis and posterior ethmoiditis. The diseased condition was eradicated. The operation was followed by the most striking improvement in the arthritis, temperature and general condition of the case. She was discharged in December, 1919. In July, 1921, she returned with a recurrence of the acute arthritis. The sphenoid and ethmoid regions, much to my surprise, were perfectly healed and clean.

A careful examination showed pus in the left maxillary sinus. This sinus was drained, and in three weeks there was a most noticeable change in our little patient. From a morose, disconsolate child, suffering from acute pain, she was changed into a happy child, free from pain. Her general appearance was wonderfully improved.

For six weeks before this little patient came into our service she received the most careful metabolic treatment and vaccines in the pediatric service without improvement of her acute trouble. The only thing that gave this little girl relief from her acute symptoms when she was six, and when she was nine, was the treatment of her paranasal sinuses.

R. A., age four, suffered from infectious arthritis involving the joints of fingers and toes. The joints were much swollen and painful. She could not walk. There was as yet no permanent deformity. When I saw her first she had bad tonsils and adenoids, plus maxillary sinusitis. Tonsils and adenoids were removed. Three months later she was much improved, but still suffered with acute attacks of arthritis, with pain and fever. The nasal sinuses were treated for one month. At the end of that time a streptococcus viridans persisted in each maxillary sinus and the arthritis remained active.

Then a small antromeatal opening was made and the sinuses treated. This was followed by relief of the arthritis. Two weeks ago—that is, sixteen months after she left our service—a report stated that she had been and was perfectly well.

W. F. is a case of recurrence of multiple infectious arthritis that recently returned to our service from Dr. Byfield, professor of pediatrics, with the following note:

"MY DEAR DR. DEAN:

"On of the boys in the arthritis deformans series has been absolutely free from trouble since the operation, which took place about two years ago, I believe. Just a few weeks ago he suddenly had a recurrence. The symptoms were pain the joints with some swelling and stiffness, also some headache and an interesting change in disposition, such as I would suspect would take place in sinus infection. I recall in this case that it was rather difficult to spot the infected area, but it was finally located, and the relief to the boy was the result. This boy has been unusually well since the operation, has had an excellent appetite and has done well in school. In a few weeks since the beginning of the recurrence he has lost weight and the appetite has been poor. The mother seems to feel that the treatment which you gave him was the thing which was responsible for his relatively long period of freedom from trouble, and she is willing to have you go ahead again and not have any orthopedic treatment until the focal infection has been studied.

A. H. BYFIELD."

W. F. is now fourteen years of age. He came into our service at the age of eleven. His tonsils and adenoids were removed July 26, 1918. On September 25, 1918, because of the continuance of his acute joint infection a second examination of his nose was made. A deflected septum with suppurative ethmoiditis was found. The examination of maxillary sinuses was negative. A submucous operation was performed on the septum and treatment instituted. At the end of two months' treatment a hemolytic streptococcus persisted in the posterior ethmoids and sphenoid of each side. These sinuses were very necrotic, and on November 7th they were exenterated. With the apparent disappearance of the sinus trouble the acute arthritis disappeared and returned only after a period of two years. Up to two weeks before the admission

on June 29, 1921, he had been free from trouble. At that time knee and ankle joints become painful and swollen. Preceding this trouble he had had, as he said, a cold and a nasal discharge persisted.

The X-ray examination of the frontals and maxillary sinuses showed them to be quite clear. With the nasopharyngoscope pus was found in each posterior ethmoid and sphenoid region. The left sphenoid was particularly badly diseased. The upper posterior sinuses were again operated and postoperative treatment was instituted. As the result, the nasal discharge is rapidly disappearing and the joints are becoming rapidly better. This case illustrates nicely the fact that when the removal of tonsils and adenoids in a child does not remove the focus of infection that the paranasal sinuses should be carefully examined. It also brings to my mind again, forcibly, the fact that in some cases a cure of paranasal sinus disease in children is very difficult.

Bronchitis is a very common result of paranasal sinus disease in infants and young children. In short, I think that every infant that has bronchitis, even if adenoids are present, should be suspected of having paranasal sinus disease, and the paranasal sinuses should be examined.

Paranasal sinus disease may be the source of infection for pneumonia.

Baby J. S., three and one-half months of age, was under our care for suppuration of the paranasal sinuses plus mastoid infection. Each mastoid had been operated upon, and the mastoid wounds were perfectly clean but not yet healed when the baby developed pneumonia. At the time we were treating the paranasal sinus disease. The baby died on February 1, 1922, and the autopsy is as follows:

The right lung is crepitant throughout, but shows no area of consolidation. The left lung is covered by a thick layer of fibropurulent material. The lung is airless, firm but of a dark color. On cut sections the entire organ is of a deep red color, firm and fairly dry. There is a small amount of free fluid which can be squeezed out of the bronchioles. The whole lung presents a fairly typical picture of bronchopneumonia.

Nasal Cavity.—The nasal cavity was opened by a lateral incision through the base of the skull, which permitted the halves of the skull to be quite widely separated. The walls of the entire nasal cavity were bathed in pus. Smears were made from this pus, and microscopic examination revealed many pneumococci. The pus was particularly thick and abundant in the superior meatus. A probe pushed backward through the superior meatus on either side entered a cavity approximately 6 mm. in diameter, which lay partially within the body of the sphenoid and was filled with thick creamy pus. The superior turbinates were cut away and the posterior ethmoids exposed. These cells were also filled with pus. The middle and inferior turbinates were then removed and the lateral walls of the maxillary sinuses exposed and removed. The sinuses were about the size of a navy bean and were filled with pus, which welled up when the wall was removed as if it were under pressure. There was no macroscopic evidence of ulceration of the mucosa or osteomyelitis. The mucosa of the sinuses was pale and edematous. Dr. Armstrong autopsied the head. Dr. Medlar, head of the department of the pathology and bacteriology of the University of Iowa, was present and both he and Dr. Armstrong expressed the opinion that the source of infection for the pneumonia was the paranasal sinus disease.

There is frequently an interdependence between paranasal sinus disease in young children and asthma. The following two letters from Dr. Byfield, head of the department of pediatrics in the University of Iowa, have some bearing on this subject:

“DEAR DOCTOR DEAN:

“You might be interested to know that Orville Schuler, aged eleven years, has been returned to our service for observation. This patient has had asthma for nine years, the attacks coming on at intervals of about a week, previous to his first admission to this service. He received nasal sinus treatment from you, and with the exception of a very mild attack of asthma a day after his return home, he has been free from every evidence of the disease. He has been able to go to school and has lost a lot of his shortness of breath. These statements have been obtained from the patient himself and are, as far as we can tell, reliable.

ALBERT H. BYFIELD.”

"DEAR DR. DEAN:

"We have just heard from the parents of eight-year-old Roy Schulz and twelve-year-old Emmett Martin, in reply to circular letters. Each one of these children had one mild attack of asthma a few days after leaving the hospital and none since that time. This makes the third case in which satisfactory results have been obtained. ALBERT H. BYFIELD."

One of the characteristics of sinus disease in young children is headache, usually frontal, and interpreted by the parents as being due to eye strain. We may have the neuralgic type from involvement of the nasal ganglion. Sometimes the frontal pain is very excruciating. It is interesting to note that occasionally a tuberculous meningitis beginning will cause the same type of pain as an acute frontal empyema. In acute paranasal sinus disease the patient also complains usually of nasal stoppage or a feeling of fullness in the head.

Infants do not complain of headache. Dr. Byfield is of the opinion that a child complains of headache first in the neighborhood of from five to seven years. He reports that in Dr. Still's textbook, in discussing the migraine of childhood, he mentions that at the age of five years is when the first complaint of headache is usually made.

The following case is very interesting: Mrs. S., aged 44, came complaining of right sided headaches, beginning at the age of six years. Frequently attacks of pain in right forehead and right eye. The headaches have always been of this type. Many times a diagnosis of migraine has been made, and she assumed that this was a headache which was to remain with her for life. In examining the paranasal sinuses, when a maxillary sinus was irrigated the patient immediately said that the pressure caused the typical headache. Eradication of a chronic maxillary sinus disease resulted in an immediate and permanent disappearance of a headache which had persisted for thirty-eight years.

In children, fever usually accompanies acute paranasal sinus disease. In infants the fever is usually very high, 103 to 105½, with daily remissions. It is axiomatic, I believe, with pediatricists that in all cases of fever in infants where the cause is not definitely known, the ears should be examined. As I

view it, the examination of the paranasal sinuses is of equal importance. The fact that an acute ear is present does not exclude acute paranasal sinus disease, and the individual who has in his care an infant with an acute suppurative otitis media in which, after myringotomy fever persists, and who does not make an examination of the paranasal sinuses is liable to make a serious mistake. I have seen several cases where mastoidectomy had been recommended in infants where the cause of the fever was infection of the paranasal sinuses, and the fever disappeared with the treatment of the paranasal sinuses.

Recurrent fever in infants and young children without apparent cause is sometimes due to disease of the paranasal sinuses.

Three years ago, I. H., then seven years of age, was referred to us by Dr. Byfield. He gave a history of attacks of sudden elevation of temperature of about 102 without apparent cause. During the attacks of fever the boy was not ill. He seemed slightly indisposed, and the fever was found by the use of the thermometer. This condition had begun at about the age of two. It had been made better by the removal of the tonsils and adenoids one year before, but persisted. Three years ago the paranasal sinus disease which was present was eradicated, and his trouble has completely disappeared.

Periodic vomiting may be associated with disease of the paranasal sinuses.

F. M., six years of age, came into our service suffering from attacks of recurring fever with vomiting. These attacks are complicated by acidosis. The eradication of an ethmoiditis resulted in a disappearance of the attacks of vomiting and fever.

The work on the paranasal sinuses was done almost two years ago. Three months ago a report from the boy stated that he had not had any trouble up to that time.

The following is the report of a case of periodic vomiting that was very carefully studied by us and in which the result was disappointing:

L. D., age 19 years, entered our service with the following history: Since the age of two he has suffered from periodic vomiting. There is one attack every two to four weeks. The internists are of the opinion that at this time there is a decided functional element in the case. The first attack at the age of two and every one since has the following history: Cold in the head followed by dull headache in frontal region and top of the head, vomiting. Chronic suppuration of all the paranasal sinuses except the left frontal was found. All sinuses have been drained. The number of attacks of vomiting have been greatly decreased, but he still has an occasional very severe attack. We cannot help but feel that in the beginning this was periodic vomiting due to paranasal sinus disease, and that later a functional element appeared in the case so that the eradication of the paranasal sinus disease did not result in a complete cure.

A most common complication of paranasal sinus disease, especially in infants and young children, is gastrointestinal disturbance. This is usually so severe that it is thought to be the primary trouble. As to whether this disturbance is the result of the swallowing of the nasal discharge or the result of the elimination of bacterial products through the gastrointestinal tract, I do not know. Dr. Byfield suspects that the milder cases at least are the result of the ingestion of the purulent discharges and that in the more severe cases, just as we may get an acute nephritis from the elimination of bacterial products, we have an acute gastroenteritis.

Dr. Scruton (*Larynx*, January 22, page 70) says that gastrointestinal troubles in acute otitis media are due to the ingestion of the purulent discharge from the ethmoids. This purulent discharge is also the cause of the purulent otitis. I do not think we can emphasize too strongly this point made by Dr. Scruton. We must not assume that the systemic disturbances of an acute otitis in infants are always the result of the ear lesion, because they are so frequently the result of a lesion of the paranasal sinuses.

Pyelitis may be related to paranasal sinus disease just as it is related to chronic infection of lymphatic tissue in the nasopharynx and oropharynx. In a personal communication, Dr.

Stucky told me that he had several such cases. We have had two where the elimination of the paranasal sinus disease seemed to be the thing which was responsible for the disappearance of the pyelitis.

Acute cervical adenitis in infants and young children may be the result of paranasal sinus disease.

N. N., seven years old, suffered from very extensive acute cervical adenitis with temperature of 105. X-ray showed well developed frontals. Frontals, anterior ethmoidal and maxillary sinuses blurred. Tonsils and adenoids out one year previously. This boy was very ill. Treatment of diseased maxillary sinuses alone resulted in a disappearance of his trouble in one week's time. I have seen an infant one year of age with the same condition, the result of ethmoiditis, relieved by the treatment of the ethmoiditis.

Recently, Renaud, a French physician (International Medical and Surgical Survey, December 21, 88 b., 348) expresses the opinion that the cause of death in infants who are supposed to die from gastrointestinal disturbance is frequently a suppuration of the mastoid. Our experience is that the suppuration of the mastoid in infants is frequently secondary to the paranasal sinus disease.

I trust that I am not infringing on the province of the pediatricist when I express the opinion that if the paranasal sinuses and mastoid cells are carefully autopsied in all infants who died that a surprisingly large number of acute suppurative infections will be found present in these cavities.

Certainly paranasal sinus disease is frequently the source of infection for acute otitis media. In the infant ward this winter we had an epidemic of acute suppurative otitis media. Every one of the children with infected ears had an acute infection of the paranasal sinuses. When drainage of the ear did not relieve the high temperature, treatment of the paranasal sinuses frequently did. At least four infants died, and in each of the four there was pus under pressure in the paranasal sinuses.

In the obstetric service we had a very interesting case. Baby C., seven days old. At the time of birth the mother had an acute paranasal sinus disease with an acute ear. We secured

a hemolytic streptococci from both paranasal sinuses and ear. When seven days old the baby developed fever. Examination showed suppurative ethmoids, acute otitis media bilateral. Both nose and ears were treated. Later a mastoidectomy on each side was performed. The baby gradually failed, and when two months old died. Autopsy performed by Dr. Medlar, head of the department of pathology in the university. Findings: Little pus in each tympanum; ethmoid and maxillary sinuses filled with thick pus under pressure. Cause of death, paranasal sinusitis and suppurative otitis.

Paranasal sinus disease may cause in children, but not in infants, brain abscess.

Paranasal sinus disease may cause meningitis at any age.

Dr. A. H. Andrews of Chicago (*Ill. Med. Journ.*, Nov., 1921) reports a child six years of age dead from meningitis. At autopsy the meninges were found involved from necrosis of the roof in the sphenoids. The sphenoid was filled with pus and granulation tissue. No examination of the nose had been made before death.

The ocular complications of paranasal sinus disease in infants and young children are most important. There is frequently an interdependence between the infection of the sinuses and phlyctenular conjunctivitis.

Turner, in discussing the etiology of phlyctenular conjunctivitis (*Amer. J. of Oph.*, February, '19), is of the opinion that the ethmoids are the most important etiologic factor in phlyctenular conjunctivitis. He is of the opinion that when improvement of the eyes follows the removal of tonsils and adenoids, it is due to the removal of the latter's influence on the ethmoids, which are present, that results in the improvement of the eyes.

G. B., a colored boy, aged ten years, was referred to us because of phlyctenular conjunctivitis. This boy was in the hospital for six months. When he first entered the hospital a bilateral maxillary sinus which he had was treated and eradicated. The usual local and general treatment for phlyctenular conjunctivitis was given by Dr. Boiler, the ophthalmologist. At the end of his six months of treatment his nose seemed to be perfectly clean, but the corneæ remained injected and photophobia was marked. Dr. Boiler reported that the eyes had

remained absolutely stationary for six months. The paranasal sinuses were cultured, and from the posterior ethmoids and sphenoids on each side a streptococcus hemolyticus was found. The posterior ethmoids and sphenoids were drained. Seven days after the drainage of the posterior sphenoids and the ethmoids the eyes were very much better, and in three weeks all acute trouble and photophobia had disappeared.

L. G., a little child, nineteen months of age, suffered from phlyctenular conjunctivitis, which disappeared with the disappearance of the paranasal sinus disease and reappeared when the nasal trouble reappeared.

E. L., a boy of two and one-half years of age, suffered from phlyctenular conjunctivitis. This boy had bone tuberculosis and tuberculosis of the pharyngeal tonsil plus a nontuberculous maxillary sinus disease. The etiologic factor in the paranasal sinus disease was pneumococcus, type 4. The treatment of maxillary sinuses and the injection of a vaccine prepared from the sinus discharge was of much benefit to the phlyctenular conjunctivitis. This case is interesting because the treatment of paranasal sinus disease in a patient manifestly suffering from tuberculosis was an aid in the treatment of phlyctenular conjunctivitis.

Retrobulbar neuritis is an occasional complication of paranasal sinus disease in children.

Dr. McCullough (Trans. N. Y. Acad. Med., October 26, '21) reports that in one year he saw three cases of retrobulbar neuritis secondary to paranasal sinus disease in children under fourteen years of age.

Dr. J. B. Gregg recently sent me the report of a case of retrobulbar neuritis in a child that was eradicated by the treatment of the diseased posterior ethmoid and sphenoid cells.

White (Larynx, August, '21) reports several cases of involvement of the optic nerve in children five years of age and older.

Orbital cellulitis may result from paranasal sinus disease in infants and young children.

Baby B. O., eighteen months of age, had orbital cellulitis, secondary to maxillary sinusitis and ethmoiditis. The orbital wall of the ethmoid was broken down, and the neighboring bones were also involved.

P. B., aged four, had an acute pansinusitis suppurative with orbital cellulitis on the same side. We made an opening in the maxillary sinus. The use of suction, nasal irrigation and argyrol in the nose resulted in the disappearance of the orbital lesion.

Baby H., six months of age, was in our service with a diagnosis of maxillary sinus disease secondary to posterior cleft; suppurative otitis media had developed. While the patient was under treatment for mastoid involvement an orbital cellulitis with abscess of the cheek formed. It is interesting to note that in this six-months-old baby the existence of the maxillary sinus had been proven before the appearance of the orbital cellulitis.

XXII.

OBSERVATIONS ON THE ART AND TECHNIC OF BRONCHOSCOPY AND ESOPHAGOSCOPY.

BY THOMAS HUBBARD, M. D.,

TOLEDO.

The voluminous publications of this subject rather deter one from attempting to interest those who have encountered and solved most of the problems connected with the diagnosis and operation for removal of foreign bodies from the lower air passages and esophagus. But the very nature of this work—the variety, the pathologic complications and the emergency features—gives each operator a different angle of observation, and personal experiences and conclusions aid in establishing sound methods.

Under the heading "method" one naturally thinks first of anesthesia. This refers, of course, to general anesthesia. This should be decided in accordance with the conception of the term "deliberate surgery." In foreign body bronchoscopy one undertakes a surgical operation of undetermined and perhaps extreme difficulty. It is easy to scare up arguments against ether anesthesia in all kinds of operations. Some are valid and some are not. Occasionally the risk is forced. One cannot generalize. Postulates express the individual preference too positively. Each case is a study and I desire merely to convey the conviction that prohibition of anesthesia is a handicap and tends to establish an impractical standard. But I would qualify endorsement of general anesthesia, when indicated, by the statement that the anesthetist must be one prepared to aid in the emergency disturbances incident to the operation. He must know the danger signs, warn the surgeon timely and know the restorative indications. The oxygen outfit is essential for this purpose. Posture is important and he should be experienced in this matter.

Supposing that there be dyspnea in the case presenting for bronchoscopy. First determine the location of the obstruction: Laryngeal, foreign body in the trachea or bronchus, pneumo-

nia, or a flooded lung. In so far as laryngitis is concerned, it is my experience that ether anesthesia will relieve a spasmodic, croupy dyspnea, and I would add that in the hands of the average operator there is less danger of laryngeal trauma in passing the bronchoscope in the quiet, anesthetized patient. Several of the cases in this collection had laryngeal dyspnea prior to operation, but in none has there been serious aggravation by operation. Fortunately emesis is physiologically inhibited by intubation of the larynx. No emesis with the open glottis. This makes the no anesthesia method possible, but does not condemn anesthesia. The question of tracheotomy in laryngeal dyspnea will be considered later.

A tracheal or bronchial dyspnea is not a contraindication to ether (plus oxygen if needed), and I would say the same of even bronchial flooding often misnamed pneumonia. It is in precisely the type of case having dyspnea that deliberate surgery is essential. The cause must be removed and the operator should feel at liberty to select that method which gives him the best chance of successful operation.

Sudden asphyxiation is usually due to one of three causes: Either it is shifting of the foreign body blocking the trachea or glottis, or it may slip over into the open bronchus, or it may be due to the release of pent up secretions of the invaded bronchial tract overflowing into the functioning lung. In the first instance prompt insertion of the tube will displace it into the trachea, giving temporary relief, or it may be grasped in the larynx. In the other emergencies one must depend on aspiration and removal of the foreign body.

This complication, sudden asphyxia, occurring before or after removal of the foreign body, has caused fatality on the table, and it is probably the basis of prejudice against general anesthesia. But as we get experience and study all of the factors the apparent objections to anesthesia are less convincing. In my experience the aspirator is the life saver.

This matter of bronchial flooding in foreign body cases introduces a question of pathology. We are in the habit of labeling a case pneumonia or bronchopneumonia when there is percussion dullness, typical rales or diminished or no respiratory sounds, limited thoracic expansion, confirmed may be by fluoroscope, but we should bear in mind that there is often

absence of evidence of a real infection inflammation. There may be considerable fever, due perhaps to the retained secretions. In peanut aspiration there are fragments, mouth contaminated and irritating, which produce excessive secretion in bronchi and bronchioles, but there is another factor in cases having actual plugging of a main or secondary bronchus. Intrapulmonary air pressure is normally minus 1 or 2 mm. Hg. inspiratory and plus 2 to 5 mm. Hg. expiratory in quiet respiration. In forced respiration, as in dyspnea from obstructed air passage, the inspiratory negative pressure may be as high as minus 57 mm. Hg. and in expiration plus 80 mm. Hg. This extreme range of pressure from the normal tends to engorge the delicate vascular mucosa of bronchi and bronchioles and alveoli. The still higher positive expiratory pressure would tend to unload the congested vessels, but in dyspnea due to a plugged bronchus we have an almost continuous high negative pressure below the point of obstruction of one pound (50 mm. Hg. = 2 inches Hg.), more or less, varying with the degree of obstruction and vigor of the subject. (Two pounds' negative pressure will cause decided hyperemia of the nasal mucosa, four pounds will draw blood and that, too, in tissues more tolerant of high negative pressure.) Irritation hyperemia plus negative pressure seems to account for the rapid flooding of a bronchial tract below the point of obstruction. Limited thoracic expansion is one of the cardinal symptoms of obstructed bronchus. There is evidence that this is due in part to physiologic inhibition, but it is also an indication that the air content is displaced by fluid. But this is not a true pneumonia nor an inflammatory edema, as has been made clear by McCrae, Spencer and Jackson. The proof of this is found in the fact that in many of these cases the removal of the foreign body and deep aspiration will promptly restore lung function, and within a few hours respiration becomes quite normal and the fever vanishes. Retained secretion is a foreign protein and causes the rise of temperature. A brief report of three cases will make clear the important points and the operative indications.

A baby of sixteen months had a fragment of peanut in the right bronchus for seven days. The physical examination, malaise, temperature and coughing warranted the usual diag-

nosis of bronchopneumonia. The infant nearly passed away from the flooding of the open bronchus after removal of the foreign body. With the tube in situ the mucus could be seen to well up in the tube until it reached the level of the breathing fenestra, and as it overflowed into the left it caused asphyxia and cyanosis. The pulse remained normal. Prompt removal of the tube, which was filled with the thick, tenacious mucus, turning the infant to the right side and then upending it, caused the overflow to come out of the mouth. Aspiration would have been better, but we tried the posture method in this case and it was effective. This patient had no fever after operation and recovered so promptly that the diagnosis of bronchopneumonia was not confirmed.

Another case, that of a boy of three and a half years, was sent to Toledo Hospital with a diagnosis of "arachidic bronchitis" of four days' duration. The fever ranged between 102 and 104 degrees. The radiographic plates showed the left lung to be almost airless, limited expansion of the left thorax, no excursion of the left diaphragm observed by fluoroscope, no respiratory sounds in the left thorax, respiration very rapid and the patient quite exhausted. Two peanut fragments were removed from the lower left bronchus, Dr. Galbraith operating. Probably they plugged both secondary bronchi, which accounted for complete obstruction. In this case the overflow of mucus was prevented by aspiration. The contents of the wash bottle illustrate the importance of thorough deep aspiration. (See lantern slide.) Small pieces of peanut and debris in a large amount, an ounce or two, of thick, tenacious, somewhat purulent mucus accounted for the findings of the physical examination and the high temperature. Retained secretions caused the fever. As an additional precaution this patient was turned on to the affected side even after aspiration. There was prompt relief of coughing and no fever after operation. An hour later air was entering this lung almost normally.

Metallic foreign bodies blocking one or more secondary bronchi will produce about the same degree of fever and the same symptoms of pneumonia. A brass pencil cap lodged low down in the left bronchus gave a clinical picture very similar to the last mentioned case, and the symptoms of broncho-

pneumonia vanished as soon as the pent up secretions were withdrawn after removal of the foreign body.

(These three cases are not included in the group of specimens.)

It is evident that infection is in such cases of slight degree and that the seromucus is chiefly due to irritation and the almost continuous high negative pressure below the point of complete obstruction. The inference is that the term bronchopneumonia overstates the pathologic condition. It is more of the nature of a negative pressure bronchorrhea. "Arachidic bronchitis" implies a type peculiar to peanut aspiration and undoubtedly in this accident irritating, mouth contaminated debris, is liable to enter small bronchioles, but it is probable that any foreign body that plugs the main bronchus or one or more secondary bronchi will cause about the same symptoms.

The surgical lesson is that the operation for removal of a foreign body from a bronchus is not complete until the debris and pent up secretions are evacuated as thoroughly as possible, and as a precaution against overflow into the open bronchus the patient should be turned on to the affected side.

Now a few words concerning tracheotomy. The lantern slides and legends show the contrast between prebronchoscopic days, the early period of bronchoscopy, and present day practice. The real indications for tracheotomy are either of emergency type or to aid in certain extraction problems. For instance, in laryngeal impaction tracheotomy may be forced. An extreme degree of laryngeal obstruction will cause anxiety, even after extraction of the foreign body which has caused it, and rather than run the risk of being forced to do it in a hurry it is well to get a cannula in promptly. I have had no experience with postoperative intubation, but an inflamed larynx does not tolerate a tube well, and extubation is liable to be delayed—a rather serious complication. As stated, none of the cases in this series showed postoperative evidence of laryngeal trauma.

In foreign body lung abscess tracheotomy is indicated to aid in the aspiration of purulent contents. It is a nasty job to work showered with foul pus, and this can be avoided by a few days of frequent aspirations prior to exploration by the bronchoscope.

The lower route aids in reaching and exploring the orifice of the upper right lobe bronchus for removal of a foreign body, the angle of approach being more favorable than by the upper direct method, and also the shorter tube makes easier the mechanical manipulations in complicated conditions conducted, if necessary, under the guidance of the fluoroscope.

There is an interesting phenomenon connected with this matter of prying around in the trachea and in the bronchus. I have observed syncope not due to asphyxiation, a sudden slowing of the pulse rate. In one case my associate, Dr. Galbraith, was searching the lower left bronchus for some more peanut fragments, two already extracted. The pulse dropped, as the anesthetist estimated, to less than 30, and it promptly came back to normal when the extension tube was adapted to the proper axis. Pressure on or tension of the vagus filaments to the cardiac plexus may be the cause of inhibition. It is the duty of the anesthetist to watch for such disturbances and warn the operator timely. Probably some fatalities of this type are ascribed to status lymphaticus.

The nature of esophagoscopy is similar to bronchoscopy, but the anatomic construction and frequent impaction complicate and add a factor of trauma. Above all this, work must be deliberate, and to that end general anesthesia is indicated, excepting, of course, the obviously easy ones. Untimely emesis may become a real complication. Dr. Jackson has delineated the complicated mechanical manipulations necessary, and certainly one must have the aid of complete relaxation and forget the time limit to do this kind of work deliberately.

Posture is a matter of great importance. In adults one can get a suggestion of the esophageal axis by examination of the dorsal vertebral curve. I think that the operator can keep his sense of orientation better by the supine horizontal posture as the standard, varying slightly to keep exactly in the axis of the tube explored.

A few words about open safety pins in the esophagus: The most popular type is made of brass, and fortunately this is less dangerous than the plated steel pin, as it is less sharp and more flexible. In this group fifteen cases presented the hook method of reversing the point was used. Only one was extracted by

forceps, and that is the only case in which there was trauma. This child had a throat infection on the way, having traveled far, and the trauma of extraction aggravated the cervical adenitis and general cellulitis. In this case the guard was imperfectly attached and was pulled off by the hook, leaving the pin crosswise until it was grasped by forceps and extracted.

It should be added that one must study the plate measurements to determine if turning the open pin is practical, and if not the shield hook method, covering the point and pulling it into the beveled lip of the tube, or the method Dr. Jackson now advises should be resorted to; that is, grasping the point and shielding it in the beveled tube end.

This special art has enabled the trained vision to penetrate deeply into the naturally obscure anatomic regions to meet surgical indications with precision and study with accuracy hidden pathology. I should like to put into words sentiments of appreciation of the work of the founders of this surgical art. Endoscopy is peculiarly spectacular, and it is high tension work with startling end results. Following the moment of the exaltation over a surgical achievement there comes to mind the men who have written this chapter in the history of laryngology. Joseph O'Dwyer developed the art of intubation of the larynx, and Gustav Killian and Bruenings perfected tubes and proximal illumination. Ingals and Coolidge imparted the inspiration to their colleagues. Jackson has blazed a new way in the perfection of the technic and instrumentation and established standards that will keep the next generation alert. Mosher, Lynch, Arrowsmith and Lynch have done foundation work in special lines. Many others have contributed to perfect detail. We honor them when we realize on their ideals.

XXIII.

THE RADICAL FRONTAL SINUS OPERATION, WITH REPORT OF CASES.

By FIELDING O. LEWIS, M. D.,

PHILADELPHIA.

In a large percentage of cases in which there is a chronic, suppurative process of the frontal sinus, the radical operation affords the best means of a permanent relief from such distressing symptoms as recurring or persistent pain and headaches, purulent nasal and postnasal discharge, alarming vertigo, gastrointestinal lesions and focal infections. There is a certain group of cases in which some form of radical procedure is unquestionably the only method of treatment. I would mention in this connection those cases with external fistulae, intracranial complications, extremely large sinuses, with their often present septal divisions, bone necrosis, severe orbital complications, and when the intra-nasal operation has been unsuccessful.

By radical operation is meant the Killian, or some of its many slight modifications. This type of operation affords the surgeon the opportunity of carrying out certain surgical principles which are essential to success in these cases. By the Killian method of approaching the sinus, it is possible to visualize the entire field of operation, which is the only definite way of determining what is within the sinus. If foreign bodies are present, as in one of my cases, a piece of drainage tube was removed; if bone cysts have formed, three of which were found in another case; if anatomic variations (which is the rule rather than the exception) are encountered; if the mucous membrans of the sinus is hyperplastic, with its ever present polypoid formation; if there is necrosis of the posterior plate—a thorough house cleaning is, to my mind, clearly indicated. This cannot be accomplished by chiseling a small hole through the anterior plate, any more successfully than a mastoid operation can properly be performed through a small opening in the mastoid cortex. The intranasal operation would be about

as useful as a needle puncture for the cure of chronic suppurative maxillary disease.

In my somewhat limited experience in about forty cases operated on radically, a complete removal of mucous membrane, a careful examination of the septa when present, as diseased cells are often concealed at their base, and good nasal drainage, are imperative in order to secure a complete cure. Careful postoperative treatment is always a feature often neglected. The case should be watched, dressed and treated by the surgeon or his assistant who is fully familiar with these cases.

While some writers mention the decline in popularity of the radical operation in favor of the intranasal route, I wonder if the intranasal operation, even in suitable cases, has been all that its advocates have desired. In my own experience, with one or two exceptions, it has accomplished no more than that secured by intranasal drainage through removal of hypertrophies and septal deviations.

A postoperative deformity depends, of course, upon the size of the sinus and the amount of necrosis of the anterior plate. With such brilliant results being now obtained by plastic surgery, marked deformities should be readily corrected by the transplantation of bone, cartilage or fat. I have found that the patients, particularly those past the age of vanity, are so delighted with the cessation of the symptoms, that they prefer to retain their defect, though sometimes marked, rather than to submit to what some have feared might be a return of the old trouble.

From a series of some forty cases I have selected a few, which to me have presented interesting pathological and surgical problems.

Case 1.—On account of the unusual symptoms and extensive involvement of all of the sinuses, this case is reported more or less in detail. W. B., male, aged 54 years; married. Occupation, house painter for the past 25 years. Was admitted to the medical ward of Jefferson Hospital in December, 1921, suffering with bronchial asthma. Chief complaint: Shortness of breath. Family history: Nothing of interest known. Personal history: Used alcohol and tobacco moderately. Had typhoid fever in 1879; pneumonia in 1890. Denies venereal disease.

Present illness: In January, 1911, patient had his first attack of asthma. Was engaged in inside painting when first attack occurred, which lasted two days and he was away from work one week. Mild attacks of short duration followed at various intervals for seven years. Three years ago he had another severe attack; since that time the asthmatic attacks have come on at irregular intervals in close sequence and at all times of the year. There seems to be no seasonable influence. For three years he has received autogenous vaccines. The vaccines exaggerated the attacks.

Condition on admission: A poorly nourished adult, white male. Marked gastric symptoms, and breathing so difficult that he was unable to lie down.

Physical examination: Eyes and ears normal. There is a large septal perforation following a submucous resection some years ago. There are nasal polypi in both ethmoidal regions and evidence of ethmoidal exenteration. Practically no nasal discharge visible. Marked evidence of oral sepsis from diseased teeth. Thorax, abdomen and extremities negative. Urine, faint trace of albumin; occasional hyaline and granular cast. Complete blood count shows 18,800 white cells and slight variation in size, shape and stain of red blood cells. Sputum on numerous occasions negative of tubercle bacilli. Many gram positive diplococci. Gram positive streptococci and staphylococci. Blood, Wassermann negative. Patient's attacks are relieved by the administration of hypodermic injections of adrenalin, chloride and nitroglycerine. Nitrate of amyl pearls and large doses of morphin were given on various occasions. Rigid diet was also instituted. While in the medical ward the progress had been very unsatisfactory. Injections of dust extractions gave no relief, and the patient had often as many as six asthmatic attacks in twenty-four hours, which became more severe in character. So severe were the attacks that inhalations of ether were administered, as large doses of adrenalin chloride and half grain doses of morphin were of no avail.

Following an examination of the nose and throat, the patient was transferred to the laryngologic service. X-ray studies by Dr. Manges showed considerable cloudiness of both frontal, both ethmoidal and maxillary sinuses.

Operation: December 31, 1921, under intratracheal anesthesia, the right frontal sinus was first exposed by the Killian method. The sinus was found quite large, and filled with a peculiar mucoid substance. There was necrosis of the anterior plate, and the septum between the frontal sinuses was necrotic. The left frontal sinus was then opened and the dura was found exposed by necrosis of the posterior plate for an area the size of a twenty-five cent piece. Both maxillary sinuses were opened and found equally diseased, with marked necrosis of the outer wall and the nasoontral wall. The remaining ethmoidal cells were found diseased and exenterated. The sphenoidal sinuses were also found to contain pus. From the amount of bony necrosis of the entire skull, and from the character of the discharge, tertiary lues was suspected. Though a negative spinal fluid examination was found, the patient was given neosalvarsan. Almost immediately following the extensive operation on all the sinuses and the administration of the neosalvarsan, the patient showed marked improvement, which continued until his discharge on February 14. While he has some attacks of asthma, they have been far less severe and much less frequent.

Case 2.—J. F. F., male, age 31; married. Occupation, postal clerk. Patient was seen in consultation on July 2, 1921. Chief complaint: Pain in right frontal region. Some nasal discharge. Symptoms of constant cold and epistaxis. General health good. Family history: Father died of carcinoma; mother dying of the same disease. Personal history: No severe illness until the present time. One child living and well.

Examination: The right nostril was filled with a freely movable, hemorrhagic growth about the size of a large white grape, attached to the middle turbinate. Bleeds freely when touched. On transillumination, the sinuses were unusually clear. X-ray examination negative. Under local anesthesia the growth was removed with a portion of the middle turbinate and sent to the laboratory for examination, report of which was given as an epithelioma, following which 50 milligrams of radium was placed in the nose and crossfired with plaques on the outside. This was repeated in the course of six weeks.

Patient returned in December, 1921, with a return of the growth and suffering with intense headaches on the right side.

The growth was again removed and radium introduced as before. X-ray made at this time shows a normal condition of the antrum on both sides, which was clear without evidence of pathology. The sphenoid sinuses showed clearly on each side, with no increased density. The frontal sinuses are also clear.

The patient was seen again in the course of a month. The nostril was free of any evidence of growth, but the patient's headaches had increased to such an extent that he was unable to sleep or attend properly to his occupation. He had occasional attacks of vomiting. His general condition gradually grew worse and was admitted to the Jefferson Hospital for further observation. Further X-ray studies were made, and the right frontal sinus was found cloudy, the other sinuses were clear. No pus could be seen in the nose. He was apathetic. Pain was so intense that morphin had little effect. Vomiting became worse, with no rise of temperature. Neurologic examination revealed all reflexes normal; the eye grounds were negative as to intracranial pressure. Wasserman was negative. Lumbar puncture showed no increased pressure and the spinal fluid normal.

Operation: On account of the extreme headaches and X-ray findings, the frontal sinus was opened externally by the Killian method, and the sinus was found to be filled with an apparent coagulation necrosis of the mucous membrane. The material of the consistency of gelatine, was removed en masse, leaving the bony wall clean and shiny. There was no evidence of any bone involvement. The sinus was treated in the usual manner. The patient's symptoms were not relieved, and death occurred at the end of the first week. A bacteriologic examination of the material was sterile. Postmortem examination was refused.

Remarks: It at once occurred to me whether it was possible for the radium to have had such effect upon the mucous membrane of the sinus, and if so, did the radium affect the brain cells?

Case 3.—A. R. H., male; married; aged 43 years. Occupation, bookkeeper. Admitted to the Jefferson Hospital, Philadelphia, September 21, 1910.

Personal history: Had scarlet fever and diphtheria when a child. Has had more or less discharge from his nose since childhood. Nasal polypi were removed by his family physician a month before his admission.

Present illness: Chronic, yellow, foul and profuse discharge from the left nostril. For the past few weeks has had severe pain and some fever.

Condition on admission: General physical examination negative. The left eye was completely closed by a swollen upper eyelid. Extreme redness and marked tenderness. Photophobia and marked lacrimation. Examination of the nose showed both nostrils filled with nasal polypi and a mucopurulent discharge. X-ray showed involvement of the left frontal and both ethmoidal sinuses.

Operation: Nasal polypi were first removed under local anesthesia. The frontal sinus was then opened by the Killian method, under general anesthesia. The entire anterior plate was necrotic and the sinus was filled with pus and polypoid mucous membrane. The packing was introduced with external drainage and the patient made an uneventful recovery.

Three years later, the patient returned with a swelling in the same location, but an absence of redness and tenderness. On reopening along the line of the former incision it was found to be a mucocele, which was thoroughly curetted, packing again introduced, and the patient has had no further trouble up to the present day.

Case 4.—Dr. W. W. W., male; married; aged 33 years. Admitted to Jefferson Hospital October 15, 1921. Family history negative.

Personal history: Patient had a gastroenterotomy during his college course, for gastric ulcer. Has had a purulent discharge from the nose following repeated attacks of cold, while a student. Both maxillary sinuses were operated on radically, also exenteration of the ethmoids on both sides.

Present illness: Patient complains of severe headaches, more pronounced when the nasal discharge is scant. Attacks of loss of consciousness, epileptiform in character. Loss of weight and inability to practice his profession.

Condition on admission: Polyps were found in both nostrils in the region of the ethmoids. Mucopurulent discharge

more pronounced in the left side. Transillumination of the sinuses shows a darkened area over the frontal region. X-ray showed marked involvement of the left frontal sinus, cloudiness of the right. Blood Wassermann negative.

Operation: On November 15, 1921, under intratracheal anesthesia, a double Killian operation was performed. Both sinuses were extremely large and deep, with several septal divisions. In the left frontal sinus were found three bone cysts, the largest being about the size of a robin's egg. The other two were somewhat smaller. These contained an amber-colored fluid. There was no necrosis of the posterior plate.

Subsequent history: When last seen, a few weeks ago, the patient had gained twenty pounds in weight, was attending to his daily country practice, and has had no further attacks of epileptiform seizures and no nasal or postnasal discharge.

Case 5.—L. B., female, single; aged 59 years. Admitted to Jefferson Hospital January 29, 1920. Family history negative.

Personal history: Some two years previous had an attack of influenza. This was followed by a purulent nasal discharge and swelling in the region of the left frontal sinus. An external opening in the frontal region was made by a surgeon, and the sinus curetted. Has had a constant discharge from an external sinus in this region almost continuously, with a purulent discharge from the nose.

Present illness: Complains of severe headaches, discharge from an external fistula above the left eye, and purulent discharge from the nose, and frequent colds.

Examination shows a fistula extending into the frontal sinus, some polypi, and a mucopurulent discharge in the left nostril. X-ray report shows slight cloudiness of the left ethmoid cells and to a less degree of the right. Left frontal sinus apparently obliterated by a former operation. Maxillary sinuses normal. Blood Wassermann negative. General physical examination negative.

Operation: Under intratracheal anesthesia the sinus was exposed along the line of the previous incision. The sinus was found to be filled with pus and granulations. The wound was packed in the usual manner.

Subsequent history: A few months following the operation the patient had some discharge in the region of the old fistula and marked deformity at the inner angle of the wound. Under anesthesia the fistula was again curetted and packed and the deformity corrected by a plastic operation. For the past year there has been no evidence of any discharge of further symptoms.

Case 6.—C. B., male; married; aged 41 years. Occupation, traveling salesman. Admitted to Jefferson Hospital March 7, 1920. Family history negative.

Personal history: For the past five or six years the patient has had severe headaches which were diagnosticated and treated as migraine. Had consulted many physicians, and relief could only be obtained by hypodermic administration of morphine. Blood Wassermann had been made repeatedly and always found negative. No X-ray examination had ever been made up to the time of his admission.

Condition on admission: No tenderness or swelling in the region of the frontal sinus could be obtained, and no purulent discharge could be found in the nostrils. Transillumination showed a darkened area in the region of the right frontal sinus. X-ray showed a rather large sinus and extremely cloudy. The other sinuses were apparently clear. General physical examination negative.

Operation: Under intratracheal anesthesia the frontal sinus was exposed in the usual manner and found to be filled with thick, creamy pus. The mucous membrane was thoroughly removed and free nasal drainage instituted. As the ethmoids did not seem to be involved they were not disturbed. The patient made an uninterrupted recovery.

Subsequent history: Has had no further symptoms referable to his sinus, has had occasional headaches, but less severe than before the operation.

Case 7.—H. D. C., male; married; aged 39 years. Was admitted to Jefferson Hospital June 22, 1921. Family history negative.

Personal history: For several years the patient has complained of recurrent headaches and postnasal discharge. Had consulted physicians repeatedly without relief. Right frontal sinus operated on one year ago. Discharging fistula since.

Was referred by a former patient, who had had a frontal sinus operation.

Condition on admission: General physical examination negative. Wassermann negative. There is a discharging external fistula over right frontal sinus, pus in right nostril. No polypi. X-ray report by Dr. Manges showed marked cloudiness of right frontal sinus. The sinus was considerably larger than the left. The other sinuses were clear.

Operation: Under intratracheal anesthesia the right frontal sinus was exposed by the Killian method and was found divided by four distinct septa, each compartment filled with polypoid degeneration of mucosa and pus. Two external iodoform drains and one intranasal iodoform drain were introduced and the wound closed in the usual manner.

The patient was discharged in ten days, with a cessation of all symptoms.

Case 8.—Mrs. C. J. H., aged 33; married. Admitted to Jefferson Hospital July 13, 1921. Family history: Father died of tuberculosis. Personal history: General health good until October, 1920.

Present illness: Has had repeated colds since March, 1921, complicated by acute bronchitis and some symptoms of asthma. Shortly afterward had severe pains over the left supraorbital region and radiating into the eyeball. Frequent nausea and vomiting. Vertigo for the past week, and spots before the eyes. Thick, foul nasal and postnasal discharge.

Condition on admission: Negative, with the exception of the purulent nasal and postnasal discharge, and hypertrophied tonsils. Wassermann negative. Temperature, pulse and respiration negative, urine clear. X-ray by Dr. Manges: "There is marked cloudiness of the left frontal sinus, the left ethmoid and left maxillary antrum. The frontal sinus is rather large. There is an abscess apparently at a molar tooth, the crown of which has been destroyed, in the left upper jaw. This is rather close to the antrum.

Operation: Under intratracheal anesthesia, the usual Killian incision was made, exposing the left frontal sinus, which was filled with foul pus and granulations. There was also partial destruction of the supraorbital ridge by necrosis. As much of the ridge was left as possible, to avoid a marked de-

formity. The left maxillary sinus was operated on radically by the Denker method, the sinus being filled with pus and polypi. The diseased tooth, which extended into the maxillary sinus, and was no doubt the cause of the infection, was extracted at the same time.

The patient was operated on July 14, 1921, and discharged July 22, 1921, with absence of all previous symptoms.

Case 9.—H. K., male; aged 37 years; married. Occupation, railroad brakeman. Was admitted to Jefferson Hospital November 10, 1921.

Chief complaint: Chronic, profuse, foul nasal discharge and frontal headaches. Family history: Negative. Personal history: Negative.

Present illness: For some months has had intermitten swelling with pain over the left eye, following an acute cold in the head. Feeling of heaviness in the head; some slight dizziness; noises in the right ear, and slight deafness.

Condition on admission: Well nourished man. Profuse, purulent discharge in the left nasal chamber. General physical examination negative. Blood Wassermann negative.

X-ray by Dr. Manges: "I am convinced that the patient has a left frontal sinus, although it is not quite as large as the right one. I feel that this sinus has been occluded for a long time and that there has been considerable bone thickness such as you get in a mastoid, and that the natural, smooth outline of the sinus is destroyed. I believe that you will want to do a radical operation and I would advise that you make a small opening at first, because I am not certain how far down the sclerotic bone extends."

On transillumination, the left maxillary sinus was found cloudy. Paracentesis revealed a large amount of foul-smelling pus.

Operation: Under intratracheal anesthesia, the left frontal sinus was exposed in the usual manner. The sinus was found quite large, contrary to the findings of the X-ray, and when opened, a large quantity of foul-smelling pus gushed out. There was also considerable necrosis of the anterior plate. The left maxillary sinus was operated on radically by the Denker method and found to contain a large amount of pus and poly-

poid tissue. The patient made an uninterrupted recovery and has had no further complaint.

Case 10.—L. C., white, female; aged 10 years.

Chief complaint: Swelling of the right eye, with pain, redness and fever. Nasal and postnasal discharge.

Family history: Mother and father living. Three sisters and three brothers living and well.

Personal history: Had diphtheria when eight years old. Tonsils and adenoids were removed about a year and a half previous to present illness.

Present illness: The patient's mother stated that there had been a nasal and postnasal discharge, purulent in character, for several months past. Five days before the patient consulted the ophthalmologic department of Jefferson Hospital, a swelling was noticed with pain about the eye. No symptoms of this character had previously been noticed. The patient was admitted to the eye department of the Jefferson Hospital February 22, 1921. Under anesthesia the ophthalmologist made an opening into the orbit, thinking the condition was primarily an orbital infection. On introducing a probe, he found that the disease extended into the frontal sinus. The patient was then referred to the nose and throat department.

Examination: Well nourished, female child. The right eye was closed by swelling and marked induration of the upper eyelid. Examination of the nose showed polypi and mucopurulent discharge in the right nostril. X-ray examination reports marked involvement of the right frontal sinus and right ethmoid. Left side clear. Blood Wassermann negative.

Operation: March 1, 1921, under general anesthesia, the usual Killian incision was made over the right frontal sinus and the sinus exposed, which was found filled with pus and granulations and the anterior plate necrotic. The ethmoids were also found diseased and were exenterated. The usual dressings were applied and the patient made a rather prolonged recovery because of a more or less persistent discharge through a fistula, which developed in the incision made into the orbit. She was discharge from the hospital in May, 1921, and has had no further symptoms.

SOCIETY PROCEEDINGS.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

Meeting of May 8, 1922.

THE PRESIDENT, DR. ROBERT SONNENSCHN, IN THE CHAIR.

SCIENTIFIC PROGRAM.

JOHN P. MINTON, Ph. D., and ROBERT SONNENSCHN, M. D., presented papers entitled:

1. "Study of Reinforcement of Sound by Means of the Schaefer Resonators."

See page 45.

2. "Use of Tuning Fork Stem for Both Air and Bone Conduction in Rinne Test."

See page 85.

DISCUSSION.

DR. EDWIN MCGINNIS asked if they had tried stuffing cotton in the middle of the tube to see if there was interference with the sound.

DR. SONNENSCHN replied that they had not.

DR. G. W. BOOT asked if they had always used the same length of tube.

DR. SONNENSCHN replied that they had and that it was twenty-six inches long. While it was impossible to demonstrate their point absolutely, it was a fact that the sound waves passed along the lumen of the tube, very little going through the wall and very little being transported by the tube wall itself.

DR. E. L. KENYON asked why they could not use a soft insert in the middle ear instead of the hard rubber tube, perhaps just the tube itself.

DR. SONNENSCHN said they had tried that, but it was hard to hold it in place. The tip being pointed held it nicely in the

ear without striking any of the outside portion of the ear. It was just the size ordinarily used with the Politzer bag.

DR. J. HOLINGER said that there has always been controversy where he could not see any reason for it. In the Rinne test we know that the handle of the tuning fork vibrates as long as the prongs do. It is therefore immaterial whether we observe the handle or the prongs, since it is only a question of time. It was the aim of Bezold to make all the tests as simple as possible. The question of human equation enters into the tests, and the less and simpler apparatus are used the more reliable and the more uniform the results will be. Also, the less the excitement of the patient the better the result will be. It is true, some points are theoretically not explained. In regard to this, Bezold uses the comparison of hearing the heart sounds by means of the stethoscope. It is not known accurately how and where the heart sounds are produced, but it is known that if there are certain changes from the normal sounds we find at the postmortem certain characteristic changes of the valves of the heart (stenosis, etc.). Nobody would go so far as to advise throwing the whole auscultation of the heart overboard because we do not know how the sounds of the heart are produced or how the abnormal sounds can be explained. In his opinion, the only way to attack the question is to say that if there is a negative Rinne in a given case and a middle ear affection is not found at the postmortem, then there is room for an argument. Observe the facts accurately, immaterial of the explanation. Many an explanation was not found because the facts were not observed accurately.

The work of Dr. Sonnenschein was important and showed that he is thinking. Dr. Holinger believes in simplifying, not complicating these difficult matters.

DR. G. E. SHAMBAUGH believed that the work with resonators will bring out some very interesting facts. The method in vogue of testing different parts of the tone scale by such means as tuning forks brought out a good many incidences where gaps in the tone scale existed; that is, where patients were not able to hear the tones over a certain area. By intensifying these tones with resonators many of these apparent gaps in the tone scale disappeared. It seems likely that with enough

amplification there might be found to exist no real tone gaps; that is, areas where one cannot hear a tone, provided the entire function of the labyrinth has been destroyed. It is a practical point of great importance in the education of a child with defective hearing; that is, training the child to speak to ascertain whether there is any remnant of hearing. By use of resonators this may be determined more readily. Even a very small remnant of hearing is often of great assistance in training a child to speak.

The study of the Rinne test is very interesting. Dr. Shambaugh believed that the Rinne test taken by itself gives more definite information than does any other single test in determining whether the cause for the defect is from obstruction in sound conduction or a defect in the sound perceiving apparatus. The Rinne test is perhaps more valuable than all other tests put together in determining this point. In making use of this test one has to take into consideration whether one or both ears are involved. A patient with a one-sided defect that is at all marked is bound to have a Rinne negative, no difference whether this defect is due to obstruction in conduction, fixation of the stapes or whether this defect is due to degeneration in the nervous mechanism.

There seems to be an impression that bone conduction can be determined separately for the two ears. As a rule, it will be found that the bone conduction is approximately the same when the fork is placed over the mastoid process in an ear where we are clinically satisfied that there has been a total destruction of function as when the fork is placed over the mastoid of the opposite normal ear. It is the exceptional case where, under circumstances of this sort, one is able to detect a slight difference in the duration of bone conduction of the two sides.

DR. JOHN P. MINTON (closing), answering Dr. Boot's question, said that the length of time the sound can be heard with the resonator is less than without it. The degrees of bone conduction in old age had nothing to do with resonance, but the change was probably due to partial degeneration of the internal ear mechanism and not at all to other changes that go on.

DR. ROBERT SONNENSCHN (closing) stated that he had the pleasure in 1909 of becoming acquainted with Dr. Schaefer and became interested in his resonators. As he had said in 1912, when he read a previous paper on this subject, the great advantage of the resonators lies in several facts. They were first made use of for experimental purposes by the great Helmholtz. As the resonators were spherical and tested the whole range of sounds from 100 to 1,000 vibrations, it was necessary to have a great many of them, and it consumed much time in shifting from one sphere to the other, besides being very expensive. Koenig in Paris also devised a set and Edelman has a set, but they all have a great many parts. Professor Schaefer constructed a very simple set consisting of four resonators, and in these he has the range of from 100 double vibrations to 1,000 double vibrations. Dr. Sonnenschein had received a letter from Professor Schaefer two days previously in reply to one of his asking if there was any work that he knew of along the line he and Dr. Minton were carrying out, and Professor Schaefer said he knew of no such work. They admitted that there might be errors. They had checked up the work and would be glad to know if others would do so and tell them their results. It was interesting to test the work out and find out whether it was worth anything from a practical standpoint.

It was very interesting to know the intensity amplification as it appears in a closed room and as it occurs out of doors. In the open the higher fork, namely, small c^3 , seemed to be amplified only five times. If they struck a high pitched fork it could be heard at a distance of five meters indoors, while out of doors one can hear the low tone a great distance.

One thing that was hard to explain was the fact that the lower tone and the higher tone were the least amplified and the middle the most, as shown by Schaefer long ago. The fact that out in the open air the intensity of the amplification is so tremendous, whereas in the room, to the examiner and the patient, the amplification for the low tones is so small, was very interesting.

What Dr. Holinger said about the practicality of the test as devised by Bezold was absolutely correct. Bezold's work was wonderful, and they were not attempting to change any

test, but felt that it would be interesting to find out if the fork could be used in a different way, especially since some European workers had condemned the Rinne test so strongly.

Dr. Sonnenschein agreed with Dr. Shambaugh regarding the value of the Rinne test and approved the simplicity of the tests, but this work was for the purpose of satisfying themselves. If anyone would check them up and disprove their results they would be glad to know the truth.

Dr. Shambaugh had called attention to the fact that it might be possible to test patients with the resonators who apparently did not hear the forks at those pitches. That might not prove whether there were gaps, for it is necessary in some cases to increase the tone intensity 100,000,000 times before the patient can appreciate it. In cases where there was impairment and not total loss of hearing of tone it might be of assistance.

DR. GEORGE E. SHAMBAUGH presented a series of lantern slides illustrating the distribution of blood vessels in the internal ear and discussed the subject of the circulation of the labyrinth.